Library

LIBRARY

JAN 9 1989

National Marine Fisheries Service
2570 Dole Street
Honolulu, Hawaii

Southwest FISHERIES CENTER

HONOLULU LA JOLLA MONTEREY TIBURON

REPORT OF ACTIVITIES September-October 1988

COASTAL FISHERIES RESOURCES DIVISION **Page**

Settlement of California Halibut in 1988 1

FISHERY-MARINE MAMMAL INTERACTIONS DIVISION

Harbor Seals Instrumented With Satellite Transmitters 7

HONOLULU LABORATORY

Submersible Dives Conducted on the Kona Coast 11

PACIFIC FISHERIES ENVIRONMENTAL GROUP

Genetic Relationships of World's Subtropical Sardines Investigated 17

PELAGIC FISHERIES RESOURCES DIVISION

TOPS Makes French Connection 19

TIBURON LABORATORY

Pelagic Juvenile Rockfishes Occurred Early and Often in 1988 22

INFORMATION TECHNOLOGY SERVICES

Progress Made on Information Technology 1995 (IT-95) Project 23

PUBLICATIONS 24

SOUTHWEST FISHERIES CENTER

CENTER ADMINISTRATION- La Jolla, California

Science and Research Director, SWR ..... *Izadore Barrett*
Deputy Director ..... *John F. Carr*
Planning Officer ..... *David J. Mackett*
Data Systems Manager ..... *Vacant*
Executive Officer ..... *Benjamin F. Remington*

LABORATORIES & DIVISIONS

Coastal Fisheries Resources Division, Chief ..... *John R. Hunter*
La Jolla, California
Fishery-Marine Mammal Interactions Division, Chief ..... *Douglas P. DeMaster*
La Jolla, California
Honolulu Laboratory, Director ..... *George W. Boehlert*
Honolulu, Hawaii
Pelagic Fisheries Resources Division, Chief ..... *Gary T. Sakagawa*
La Jolla, California
Pacific Fisheries Environmental Group, Chief ..... *Andrew Bakun*
Monterey, California
Tiburon Laboratory, Director ..... *Alec D. MacCall, Acting*
Tiburon, California

The Report of Activities of the Southwest Fisheries Center is compiled by the Technical Writing/Editing Group at La Jolla from material submitted by the Center's staff. To change the delivery address of the Report of Activities, or to cancel your subscription, please notify Lorraine C. Prescott , at P.O. Box 271, La Jolla, CA 92038. Telephone: (619) 546-7063.

COASTAL FISHERIES RESOURCES DIVISION

La Jolla, California

COASTAL EASTERN PACIFIC POPULATION BIOLOGY OF FISHES

Settlement of California Halibut in 1988

Sharon Kramer, Biological Technician, reports that the second and final year of a 2 year inshore fish survey was completed by the Southern California Wetland/Shallow Water Habitat Investigations Task.

Settlement of juvenile California halibut in 1988 differed markedly from that observed in 1987. The following differences were observed:

1. Timing of settlement in Agua Hedionda and Mission Bay was different between 1988 and 1987. Settlement occurred over the 2nd and 3rd quarters of 1988, while only a 2nd quarter peak was observed in 1987.

2. Settlement was much lower in the shallow shoreline habitat (depth m) in both Mission Bay and Agua Hedionda in 1988 than in 1987 (Figure 1) (second quarter density: 211 juveniles/habitat in 1987 vs. 21 juveniles/habitat in 1988). The reasons for the observed differences in habitat utilization are unclear; however, because the shore areas are so small relative to the areas of open water, the differences in settlement patterns do not appear to greatly influence the estimates of total abundance.

3. Overall settlement on the coast during 1988 was much greater than settlement observed in 1987. The greatest settlement peak observed in 1988 was during the 3rd quarter on the open coast, where juveniles were captured primarily in the shallowest block (depth m). The density of halibut on the open coast is half that observed in the bays, but because the area of the shallow water coastline is very large relative to that of the bays, the absolute number of juveniles along the open coast is much greater than the bays.

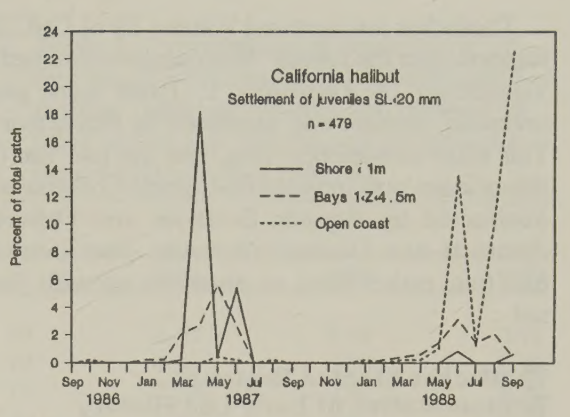

Figure 1. Percentage of the total catch of newly settled juvenile California halibut taken per month from September 1986 through September 1988.

The standing stock of newly settled halibut during peak settlement (3rd quarter) was about 250,000 fish; 77% of the 250,000 were present on the open coast.

In summary, in 1987 newly settled halibut occurred only in shallow bay habitats, while in 1988 substantial settlement occurred along the open coast in shallow water as well as in the bays. Density in the bays was much higher than the open coast indicating the bay habitat may be preferred. (S. Kramer, FTS 893-7105)

News From CalCOFI

Gail Theilacker, Coordinator, California Cooperative Oceanic Fisheries Investigations (CalCOFI), has been busy organizing the upcoming CalCOFI Conference being held at the UCLA Lake Arrowhead Conference Center, November 7-10, 1988. At the Conference the annual report on California's fisheries, chaired by John Duffy of the California Department of Fish and Game, will examine halibut, the live bait fishery, swordfish, sardine, sea urchin, kelp, and sand basses. The Symposium of the CalCOFI Conference this year is entitled "Can Marine Fisheries Be Enhanced?" The Symposium Convener is John Grant, California Department of Fish and Game, and in a point-counterpoint format, the topics to be discussed are hatchery programs, habitat enhancement, and use of sanctuaries and their limitations. Following the Symposium there will be 2 days of verbal presentations; more than 40 posters have been submitted.

Theilacker just received Volume 29 of CalCOFI Reports from the printer. Manuscripts submitted to Theilacker by February 1, 1988 were peer reviewed, revised, and published by November 1. This short turn-around time, and the fact that the Reports are now indexed by Current Contents and abstracted by Aquatic Sciences and Fisheries Abstracts and Oceanic Abstracts, peer-reviewed and free, makes them an attractive scientific journal.

Theilacker Elected Regional Representative of Early Life History Section of the American Fisheries Society

Theilacker was recently elected to a term as Regional Representative for the Western Division to the Early Life History Section of American Fisheries Society. Her primary functions for the Section are to serve as a representative for her region at Section meetings and to provide regional news on research and activities related to the early life stages of fishes to the Editor of the Early Life History Section Newsletter. To assist her in presenting good, timely information in the Newsletter, Theilacker would appreciate Bimonthly readers sending her relevant news.

Establishment of Brood Stocks of Sablefish and Dover Sole

At the NOAA La Jolla Aquarium, Biological Technician Eric Lynn and Theilacker are beginning to establish a broodstock of sablefish and Dover sole. Their goal is to maintain the stock, induce spawning, raise the larvae and begin fundamental early life history studies. To that end, they have as a target 200 of each species; to date they have about 50 Dovers and 75 sablefish. Over the last few months, Lynn with Fishery Biologist Bill Flerx, and Ron McConnaughey, SIO, collected 50 sablefish using a longline set from a skiff off the La Jolla Canyon. They also have been catching *Sebastolobus*, about 30 short spine and 20 long spine. *Sebastolobus* are being maintained for George Somero, SIO, for comparative studies of muscle biochemistry. An addition to the sablefish broodstock is anticipated later this month when Frank Shaw and Norm Parks, NWAFC, set traps at the end of their sablefish survey aboard the *American Viking* and return the fish to San Diego in the ship's live-tank. (G. Theilacker, FTS 893-7125)

COASTAL EASTERN PACIFIC FISHERIES ENVIRONMENTAL INVESTIGATIONS

Undercurrent Analyzed off Southern California

Oceanographers Ronald Lynn (SWFC) and James Simpson (SIO) are preparing a manuscript for publication entitled "The influence of bathymetry upon the flow of the undercurrent off Southern California." The study, conducted aboard the NOAA Ship *David Starr Jordan* in July 1985, is based upon a survey of the circulation found within and to the west of the Southern California Bight. The poleward-flowing California Undercurrent (CU) is most intense over the continental slope with its maximum velocity found at depths between 65 and 240 m. CU waters are further identified by being warmer, more saline and having lower dissolved oxygen than offshore waters of similar density. The Channel Islands and the submerged ridge that includes San Nicolas Island and Cortes Bank form a perforated barrier to the flow of the CU. Evidence shows that branches of the CU flow through several gaps in the ridge. The main core of the CU, as identified by the distribution of the most extreme characteristics, flows through the gap south of Santa Rosa Island. A subsurface mesoscale eddy found immediately southwest of the submerged ridge carries a large component of CU waters offshore. The eddy has a prominent zonal elongation.

This pattern of dynamic height and water characteristics demonstrates that the eddy is part of a system that carries CU waters westward beneath the California Current and out to the offshore mesoscale eddy field. Lynn and Simpson speculate that the seasonal increase in strength of the CU in June and July coupled with the bathymetric impediments to the flow create dynamic instabilities that generate such subsurface eddies which, in turn, carry CU waters westward. This subsurface flow is in large contrast to the surface circulation which has a strong component of onshore flow in this region, part of which feeds the Southern California Eddy, a seasonal cyclonic eddy centered over the outer banks. (R. Lynn, FTS 893-7084)

SURVEY SYSTEMS DEVELOPMENT AND EVALUATION

Sample Size for Detecting Seasonality of Reproductive Condition and Fish Length of Sablefish

One of the objectives of the SWFC/NWFC winter survey in 1988-89 is to examine the latitudinal variation in the timing of spawning of sablefish. To evaluate the practicality of this objective, Dr. Nancy Lo, Mathematician, examined the variability of sablefish data on reproductive activity (fraction of females with active ovaries) and fish length, and computed minimum number of trawls required to detect differences in trawl caught sablefish. No data were available at different locations along the Oregon-Washington coast in the winter, so Dr. Lo analyzed trawl samples taken in the Morro Bay area during January-April in 1987-88.

Forty-four trawl samples of sablefish collected in Morro Bay from 1987-88 cruises were examined to determine minimum sample sizes for a set of predetermined differences between two months. The results show that there was a significant effect of depth on fraction of females with active ovaries and fish length. Yet, no difference is significant between months for either the fraction of active females or fish length.

Dr. Lo computed probabilities of detecting differences between months for various sample sizes, i.e., number of trawls/month (Zar 1984). The minimum sample sizes are those associated with detecting probabilities equal to 0.70.

The grand mean of the fraction of active females is 0.26 (SD=0.25, n=42). To detect a difference of 0.30 in the fraction of active females with probability of 0.70, one requires 12 trawls per month or 60 trawls total. If the difference is 0.40, 10 trawls/month will guarantee a probability of 0.91 to detect the difference (Table 1). It is important to understand that the difference of 0.4 in the fraction of active females is a large change in the fraction from about 0.8 at the beginning of a season to 0 over about 4-5 months.

For the fish length comparison, the depth effect is more pronounced than the time effect. This may be because the data we used did not include the summer, a time when slope fishes may move inshore. The grand mean of female fish length is 537.49 mm (SD=31.29 mm, n=37). Ten trawls per depth are sufficient to detect a difference of 54 mm (10% of the mean) with a probability of 0.82. A similar conclusion was reached for male fish. The grand mean of male fish length is 501.21 mm (SD=26.48 mm, n=37).

Table 1. Probabilities of detecting a; difference, D, in fraction of female with active ovaries between months for number of tows per month (m), based on data collected in Morro Bay 1987- 88.

	D		
m	0.20	0.30	0.40
10	0.30	0.60	0.91
12	0.35	0.74	0.95
15	0.50	0.88	0.99
20	0.70	0.95	0.99
30	0.86	0.99	0.99

The analysis shows a strong depth effect on reproductive condition and fish length, but little seasonality of reproductive condition and fish length. If the populations in the north and south have a different spawning season, 10 trawls per area may be sufficient to detect a difference of 0.40 for the fraction of females with active ovaries. Hence, to detect a latitudinal change as large as 0.4 in a fraction of active females at the same time of year would require the reproductive cycle to be out of phase by possibly 3 months. (N. Lo, FTS 893-7123)

COMMERCIAL AND RECREATIONAL FISHERIES RESEARCH FOR MANAGEMENT

Success Rate Versus Catch Rate as a Measure of Angling Quality

To measure the effect of the fishing quality on decisions made by marine anglers, Cindy Thomson, Industry Economist, has explored two alternative measures: (1) catch rate, which is defined as number of target species caught per fishing trip, and (2) success rate which is defined as frequency (probability) of catching target species. Thomson computed these alternative measures from recreational landings for central California collected during the 1985-1986 Bay Areas Sportfish Economics Survey (BASES). Fish catch data were obtained from NMFS's Marine Recreational Fishery Statistics Survey (MRFSS).

Creel survey samples frequently contain a small number of observations for which catches are inordinately large. With these highly skewed catch distributions, mean catch rates are significantly affected by whether and to what extent these outliers are included in the computation. For this reason, it can be worthwhile to examine other characteristics of the distribution which may be less sensitive to the outliers, but which nevertheless capture the effect of fishing quality on the demand for recreational fishing. Success rate is one such alternative measure which appears to explain angler behavior as well as the commonly used catch rates.

Analysis of the MRFSS data indicates that landings of some target species (e.g., surfperch from beaches and piers, striped bass from beaches, albacore from partyboats) can be described by a class of statistical distributions known as Neyman distributions. For each of these target species/mode combinations, Thomson used a chi-square test to determine which Neyman distribution best fit the data. In each case, she found no difference between the sample distribution and the best-fitting theoretical distribution at the 0.05 level of significance.

The following figure describes the best fit obtained for albacore landings made from partyboats. In the case of albacore, the best-fitting Neyman distribution was the one which provided a value for P_o (the proportion of anglers predicted to land no fish of the target species) which most closely approximated the P_o observed in the sample. This tendency was also observed for all the other target species/mode combinations described above. It is also consistent with the published literature relating to other attempts to fit data to this family of distributions (Figure 2).

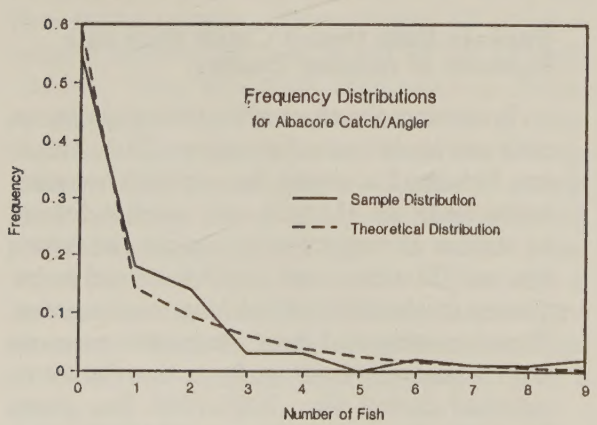

Figure 2. Frequency distributions for albacore catch/angler from partyboats in the Monterey area, 1985-1986.

Given that the shape of the best-fitting Neyman distribution is largely related to the value of P_o, Thomson included the observed success rate (computed as $1-P_o$) associated with each major target species as an explanatory variable in her model of site choice (previously described in the May-June 1988 SWFC Bimonthly Report of Activities). She then re-estimated the model using catch rates in lieu of success rates. Chi-square test results obtained thus far indicate that success rates do just as well as catch rates in explaining site choice. This is true even for those target species (e.g., rockfish from partyboat and private boat modes) which do not follow the Neyman distribution. One reason for this may be that, even for the non-Neyman distributed species, success rates tend to be highly correlated with mean catch rates. In addition, success rates also convey some information regarding the "riskiness" of a particular fishing activity (values near zero being associated with "gamefish" and values near one with "food fish").

While economic studies tend to rely heavily on catch rates to measure the quality of the fishing experience, other characteristics of catch (such as success rates, size of fish, etc.) should also be considered for use in recreational demand models. This current research represents a step in that direction. (C. Thomson, FTS 893-7115)

Impacts of Changes in Entangling Net Landings Analyzed

Industry Economist Sam Herrick has estimated the economic impacts associated with changes in the level of exvessel sales by the California entangling net (e.g. gill net and trammel net) fisheries over the 1981-1986 period. Herrick employed multipliers from the California Interindustry Fisheries Model (CIF, King and Shellhammer, 1982) to predict the direct, indirect, and induced changes in California employment, output, and household income due to year-to-year changes in the exvessel sales of the entangling net fisheries (Table 1). The scope of the study included (1) drift gill net fisheries for shark, swordfish, and other pelagics species; (2) set net fisheries for California halibut, croaker, rockfishes, and other species. It does not include the lucrative roe herring fishery.

The results presented in Table 2 reveal that there was a 74% overall (direct + indirect + in-

duced) increase in output, household income and employment in California due to the growth in entangling net exvessel sales over the period. However, this assumes that there was no offsetting decline in the value of landings by other California fisheries that interact with the entangling net fisheries. In other words, the impact model assumes that expansion in one sector is not at the expense of other sectors. This can be a problem in fisheries where several gears compete for the same species (e.g. harpoons and entangling nets for swordfish). When this is the case, economic impacts will primarily reflect distributional shifts in economic activity, not aggregate changes.

The estimated impacts consider only economic activity associated with fishing and exvessel sales. Since the California entangling net fisheries are primary producers, these impacts are generated by purchases of locally provided

Table 1. California entangling net landings by species/species group, 1981-1986.

	Landings (tons)					
Species	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**
Bass, White Sea	359	57	50	56	91	83
Halibut, CA	410	397	252	279	453	414
Opah	51	57	50	167	181	83
Pac. Bonito	103	57	50	56	363	83
Rockfish, Bocaccio	205	454	353	780	1359	2154
Rockfish, Unspec.	1026	1192	1462	725	1359	1325
Shark, Bonito	103	227	151	111	91	166
Shark, C. Thresher	923	1192	706	613	634	248
Shark, Pac. Angel	103	113	101	223	544	580
Shark, Soupfin	103	113	50	111	91	83
Shark, Unspec.	257	113	50	56	91	83
Swordfish	359	681	1008	1616	1813	1242
White Croaker	410	454	151	56	453	414
Other	718	567	605	780	1541	1325
Total	5130	5674	5042	5629	9063	8283

Table 2. Direct (D), indirect (I) and induced (IN) impacts on the California economy from changes in entangling net landings, 1981-86.

	81-82	**82-83**	**83-84**	**84-85**	**85-86**	**81-86**
Output			**($ Output/$ Exvessel Sales)**			
D (1.00)[1]	1817083	425010	3499378	4967268	- 4406401	6302337
D+I (1.634)	2969295	694509	5718333	8117012	- 7200500	10298649
D+I+IN (3.746)	6805884	1591875	13106919	18604902	- 16504176	23605403
Household Income			**($ Income/$ Exvessel Sales)**			
D (0.545)	989402	231418	1905411	2704677	- 2399285	3431622
D+I (0.736)	1337736	312892	2576242	3656903	- 3243993	4639780
D+I+IN (1.026)	1863782	435933	3589312	5094927	- 4519646	6464307
Employment			**(Jobs/$Million of Exvessel Sales)**			
D (79.300)	144	34	278	394	- 349	500
D+I (87.440)	159	37	306	434	- 385	551
D+I+IN (103.1880)	187	44	361	513	- 455	650

fishing inputs (fuel, vessel maintenance and repair, fishing gear, insurance, and supplies). The analysis assumes no further economic impacts due to processing, wholesaling, and retailing of fish landed. This assumption is appropriate, for example, if fish are sold directly to consumers by fishermen, or if the fish landed substitute for fish that would otherwise have been purchased from sources outside of California. On the other hand, if the change in landings by the entangling net fishery constitutes a real increase in aggregate fish harvest, spurred on by increased consumer demand, then the exvessel impacts stated here are an underestimate of the total economic impact. The full multiplier impacts in California would include multiplier impacts for the associated expansion in processing, wholesaling, and retailing.

In summary, the total income impact at the primary producer level associated with the expanded entangling net fishery from 1981 to 1986 is about $6.5 million. There may be further impacts due to subsequent processing activities, depending upon whether the entangling net fishery substitutes for other sources of fish or whether it represents a real expansion of California seafood demand and production. The estimates listed in Table 2 constitute the economic impacts solely of the commercial fishing activity by the entangling net fleet. (S. Herrick, Jr., FTS 893- 7111)

Completion of Groundfish Harvest Capacity Study

Drs. Dale Squires and Daniel Huppert, Industry Economists at the Southwest Fisheries Center, recently completed a study on the harvest capacity of the Pacific coast groundfish fleet. The study uses regression analysis to rate fishing vessel capacities under a license limitation system. The major findings were reported in a previous SWFC Bimonthly Report, and a comprehensive presentation has been issued as SWFC Admin. Rep., La Jolla, LJ-88-24.

Publication of Manuscript on Fishing Capital Stock

Dr. Squires recently co-authored with Dr. James Kirkley of the Virginia Institute of Marine Science, an article entitled "A limited information approach for determining capital stock and investment in a fishery, Fishery Bulletin, U.S., Vol. 86. The paper develops a method for estimating the aggregate capital stock and investment in a fishery utilizing data on vessel acquisition costs and physical characteristics. The results demonstrate that the number and change in number of vessels are inadequate indicators of the level of capital stock and investment in a fleet comprised of vessels with heterogeneous characteristics. (D. Squires, FTS 893-7113)

FISHERIES MARINE MAMMAL INTERACTIONS DIVISION

La Jolla, California

FISHERY INDEPENDENT ASSESSMENT PROGRAM

Third Annual Survey to Monitor Trends in Dolphin Abundance Continues

During September and October, the NOAA Ships *David Starr Jordan* and *McArthur* continued their survey censusing dolphins and their habitat in the eastern tropical Pacific (ETP) Ocean. The Southwest Fisheries Center (SWFC) is responsible for monitoring the status of stocks of dolphins which are incidentally killed during tuna purse seining activities in the ETP. This survey is the third in a series of at least six to monitor trends in abundance of dolphin stocks.

During the 2 months, observers on the two vessels detected 286 marine mammal schools. These included 15 schools of spotted dolphins, 8 schools of spinner dolphins and 40 schools containing both spotted and spinner dolphins. Survey effort aboard the *McArthur* was in the western and southern regions of the study area while effort aboard the *Jordan* was in the inshore and middle regions. A total of 153 and 133 marine mammal schools was detected aboard the *Jordan* and *McArthur*, respectively. During the 2 months, 76 hours of helicopter operations were conducted from the *Jordan*. At the end of each 30-day leg, aerial film was returned to the Center for development and analyses.

The *Jordan* completed a trackline from San Jose, Guatemala to Panama City, Panama, and then to Manzanillo, Mexico (Figure 1). The *McArthur* completed a trackline from Hilo, Hawaii

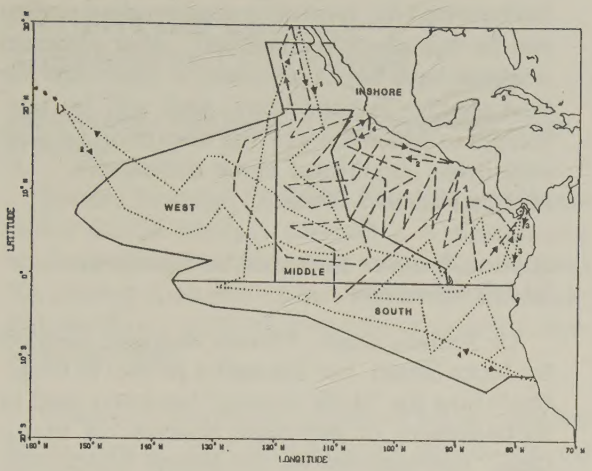

Figure 1. Proposed tracklines for the NOAA Ships *David Starr Jordan* (dashed line) and *McArthur* (dotted line) during July 28 through December 6, 1988. Scheduled port calls include Hawaii, Mexico, Guatemala, Panama, and Peru.

to Panama City, Panama, and then to Callao, Peru. During both vessels' inport in Panama, SWFC marine mammal observers switched vessels. (S. Sexton, FTS 893-7097)

Harbor Seals Instrumented With Satellite Transmitters

During October 1988, Operations Research Analyst Peter Boveng, Division Chief Douglas DeMaster, and California Department of Fish and Game Biologists Doyle Hanan and John Scholl attached radio and satellite transmitters to harbor seals on San Miguel Island. The satellite transmitters are being used in a study of harbor seal movements and stock structure. NOAA's Argos satellite system computes locations of the harbor seals by measuring the doppler shift in the transmitter's frequency as the satellite passes overhead. For additional information concerning the project see the SWFC July-August 1988 Report of Activities, page 8. Satellite transmitters were attached to a female harbor seal of 136 cm standard length and a male seal of 132 cm standard length. Radio transmitters were attached to a female and two small yearling seals. Finally, Boveng and Scholl traveled from Ventura, CA to Pt. Conception, CA to locate the harbor seals that had been instrumented during August. They detected a couple of seals that had been tagged with radio transmitters and the seal that had been tagged with a satellite transmitter. To date the animal had remained in the area where it was tagged. All tags appeared to be firmly attached and to be in perfect working order. (P. Boveng, FTS 893-7173)

Aerial Surveys of Harbor Porpoise Conducted in Central California

The fifth annual aerial survey for harbor porpoise in central California was begun on September 18, 1988. This series of surveys has been a collaborative effort between the Southwest Fisheries Center and the California Department of Fish and Game. The first two surveys (autumn of 1984 and 1985) were designed to evaluate the feasibility of aerial surveys for estimating the absolute abundance of harbor porpoise along the coasts of California, Oregon, and Washington. These surveys showed that harbor porpoise can be seen from the air when sighting conditions are good, but seeing submerged porpoises was found to be very difficult as cloud cover and surface winds increased. Studies conducted by helicopter in 1986 indicated that even under good viewing conditions harbor porpoise were visible from the air only about 25% of the time because of their diving behavior. The difficulty in sighting animals in less than optimal conditions and uncertainty in estimating the fraction of time that they are visible make it difficult to estimate absolute abundance from aerial surveys.

The current series of three surveys was designed to determine changes in harbor porpoise abundance over time. This task proved to be easier than estimating absolute abundance. The current design calls for repeated surveys of the section of coast from Point Conception to the Russian River in central California. This section of coast was singled out because it was the only region of high porpoise mortality in California gill-net fisheries. Surveys are only flown on days when weather is forecast to be much better than average. Emphasis during these last three surveys has been on the consistent replication of 25 transect lines which zig-zag between the coast and the 50-fathom isobath. The same airplane and (for the most part) the same observers have been used since 1986. New in 1988, however, is a computer automated data recording system developed under contract by Jim Cubbage (Cascadia Research Collective) in collaboration with Operations Research Analyst Dr. Jay Barlow (SWFC). The computer system is linked to the aircraft Loran and automatically records position and time whenever the recorder indicates a sighting, the beginning of a transect, etc.

This year's survey has been coordinated by Doyle Hanan (CDF&G) and Jay Barlow

(SWFC). In addition to these two, observers have included John Scholl and Sandra Diamond (both CDF&G), and data recorders have included Karin Forney and Dr. Douglas DeMaster (both SWFC). Surveys were flown on September 18, 19, 20, 21, 28, and 29, October 31, and November 1, 8, and 9. Completion of this year's survey has been delayed many times by unusually poor autumn weather. Coastal fog and low clouds has been the cause for most of the delays. The survey is expected to be completed by Thanksgiving (weather permitting) after two additional surveys are flown. (J. Barlow, FTS 893-7178)

BIOLOGY ASSESSMENT PROGRAM

Spotted Dolphin Teeth Examined for Clues of Stock Identity and History of Past Periods of Stress

Recently, Wildlife Biologist Dr. Al Myrick and colleagues described hypocalcemia in blood sampled from spotted dolphins captured after extended chase by purse seiners fishing for yellowfin tuna. Evidence of tissue resorption and subsequent repair in the dentine and cementum in teeth collected from other dolphins from the same area was also observed. A causal connection between systemic tooth resorption, hypocalcemia, and stress in dolphins and other mammals has been hypothesized (Myrick, A. C., Jr., Is tissue resorption and replacement in permanent teeth of mammals caused by stress-induced hypocalcemia? *In* Z. Davidovitch (ed.), The Biological Mechanisms of Tooth Eruption and Root Resorption. EBSCO MEDIA, Atlanta. In press.). In order to investigate this causal connection, Myrick has devised a system to record stages of hypocalcemic tooth damage. Currently, a study is underway to ascertain whether the staging method produces reproducible results. Teeth were selected from both the northern and southern offshore forms of spotted dolphins to test both reproducibility and whether the tooth resorption and repair is different between stocks.

To eliminate reader bias, Myrick had 101 samples from female dolphins coded by a coworker, Fishery Biologist Susan Chivers, to conceal the actual specimen numbers of the teeth. He then determined the degree of resorption and estimated the age of coded samples. The samples were returned to Chivers, who re-coded the samples with new identities. Myrick then read the samples, using the methods, a second time. All data collected for each animal at the time of capture were withheld until after analysis. Preliminary inspection of results indicate that the resorption stage coding system can be reproducibly employed. After statistical analyses have been completed to determine the best staging methodology, tests will be performed to determine whether resorption exhibits statistically significant stock differences. (A. Myrick, FTS 893-7092)

A New Project Initiated to Study the Stock Concept

Dr. Andrew Dizon, Fishery Biologist, assisted by Joyce Sissen, has initiated a project to investigate how the "stock concept" has been used in management of exploited species. In many cases, management by the lowest biologically definable taxa is mandated and biologically desirable. However, there is little agreement on a formal definition of stock, and there is little guidance, in either the formal scientific literature or in government regulations, on when to bestow stock status to a particular group. Formalization of the definition and process, besides ensuring that the decision is a biologically meaningful one, could help resolve current management controversies involving disputes over stock status. The granting of such status usually favors one interest group over another in terms of allocation or preservation of an impacted or exploited biological resource.

Both for management and biological considerations, the designation of "stock" really is a weak proxy for what one really needs to know: rate of exchange between putative groups or the degree of selection imposed on the immigrants (if there is a high rate of exchange). For this reason, we feel that the biological implications of management decisions based on a given stock grouping are dependent on the underlying criteria used to arrive at the decision to designate stocks. Formalization of the stock designation in these terms would be useful because it would lead to a more biologically informed management.

The project will consist of review of the literature and preparation of a manuscript that, as currently conceived, will review current methods used to identifying stocks. The biological implications of the various stock criteria will be discussed, and suggestions to formalize the decision process for bestowing stock status will also be made. This manuscript will form the focus of a planned workshop, bringing together geneticists and population biologists with fishery management specialists. (A. Dizon, FTS 893-7089)

FISHERY DEPENDENT ASSESSMENT PROGRAM

Preliminary Analysis of Observer Coverage Options

Fishery Biologist Elizabeth Edwards and Statistician Bruce Wahlen conducted a preliminary analysis of the percentage of seiner trips sampled (by placing observers on the vessels) and the resulting precision, accuracy and cost of dolphin mortality estimates.

Observers monitored incidental kill of dolphins during almost 100% of trips to the eastern tropical Pacific Ocean by tuna purse-seiners during 1987. Edwards and Wahlen have used these observer data in a sub-sampling simulation study to determine the response of dolphin mortality estimates to reductions in observer coverage from 100% to 96, 75, 50, 33, or 25% of total observed trips. They measured decay in precision as change in the coefficient of variation (CV) of the dolphin mortality estimate. They measured decay in accuracy as change in relative bias (RB) of the estimate.

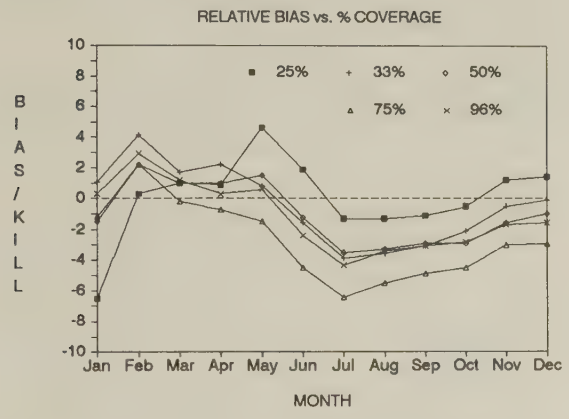

Figure 2. Time course of relative bias in estimated mortality of dolphins under sub-sampling coverages of 25, 33, 50, 75, and 96%.

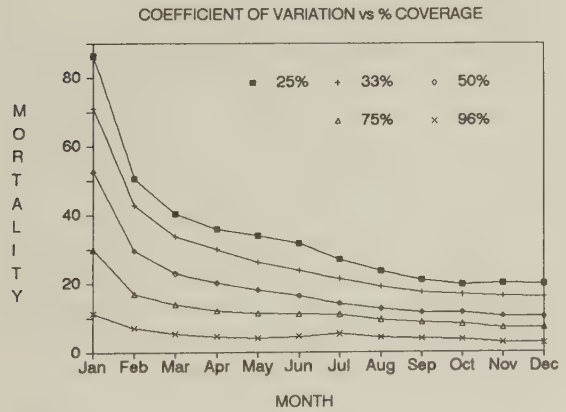

Figure 3. Time course of coefficient of variation for estimated mortality of dolphins. Estimates are of accumulated kill from January 1 through the indicated month. Estimated mortalities were based on sub-sampling coverages of 25, 33, 50, 75 and 96% of the total population of 124 observed trips.

Results are presented for total estimated kill of all species, accumulated through successive months. The mortality estimate is based on estimated kill per day (as opposed to kill per set or kill per ton). Simulated coverages included 25, 33, 50, 75 and 96%. Results reported here were based on data that were neither stratified by geographic area nor subdivided into species or stocks. Further research on these stratifications is currently underway.

They found that the relative bias (the amount that kill was over- or underestimated, on average) in estimating total kill was relatively small (generally less than 5%) and indistinguishable throughout the year between observer coverages of 50% and near 100% (Figure 2). However, the coefficient of variation (the variability of the estimates contributing to the average) of the estimate for total kill was about twice as high throughout the year when coverage was 50% than when coverage was near 100% (Figure 3).

Relative bias. All sample coverages showed a similar cyclical pattern in relative bias with time, estimated kill being slightly higher than observed kill (0.1 to 5%) from January through June but slightly lower (0 to -6.4%) from July through December (Figure 2). The negative bias later in the year is probably more important than early-year positive bias, with respect to questions of coverage and closure date, because it is unlikely that the quota would be reached earlier than mid-year. During 1986 the quota was not reached until October, and during 1987 mortality reached only 65.3% of the quota by the end of December.

The cause of this consistent but low-amplitude cyclical pattern is being investigated. It probably stems from characteristics of the data collected during 1987, and would be repeated in other years only if these particular characteristics are repeated.

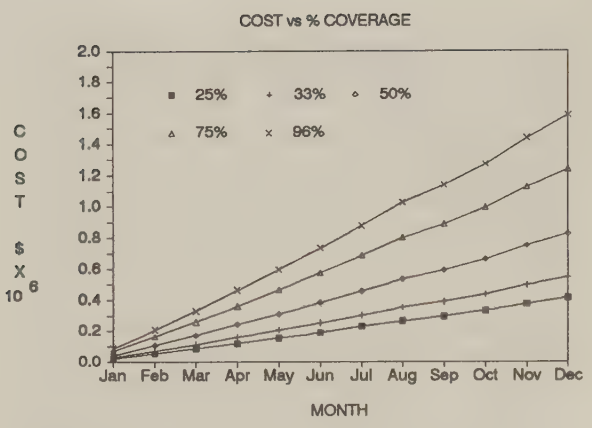

Figure 4. Time course of cost for observer program under sub-sampling coverages of 25, 33, 50, 75 and 96%. Cost was calculated assuming equal coverage by NMFS observers (@ $245/observer day) and IATTC observers (@ $190/observer day), creating an average cost of $217.50 U.S. per observer day.

Cost. Cost increased linearly with percentage of trips sampled and with time throughout the year (Figure 4). Thus, estimated cost of an observer program carried through December with 96% coverage was approximately 1.6 million dollars, twice the cost of about 0.8 million dollars for 50% coverage.

Quantitative effect of under-estimating kill (t). Generally, estimated total kill through a given month was lower than the observed kill. The effect of this underestimate on the date of closure and on total dolphin mortality is to extend the fishing season beyond the date it should have closed, until the estimated kill reaches the quota. Dolphin mortality during this inadvertent extension of the fishing season increases the actual kill beyond the quota.

However, the quantitative effects of underestimation were small under all coverages. Negative relative bias (leading to excess mortality of dolphins) never exceeded -6.4% in the latter half of the year (the most likely time for exceeding the quota), and exceeded -5% only twice (Figure 4, 75% coverage, July and August). Estimated extensions of the fishing season ranged from -7 to 17 days, affecting the total kill by approximately 35 dolphins/day. With 50% coverage the fishing season would have been extended 6 extra days; with 96% coverage the extension would have been 9 days. This longer time to closure despite greater coverage results from the greater bias associated with the 96% sample. The reason for this increase in bias with increasing coverage is being investigated.

This preliminary analysis relates to all species jointly. In progress is a stock-specific analysis of these same issues, and a consideration of the effects of varying assumptions about those animals listed on the observer records as "seriously injured." (E. Edwards, FTS 893-7099)

Dolphin Habitat Research Continues

During September and October FDAP scientists continued their involvement in the current MOPS cruises, collecting and analyzing data on the physical and biological environment occupied by ETP dolphins. These habitat and ecosystem studies are part of the NOAA Fisheries effort to examine populations which we assess as parts of ecosystems, rather than as single, isolated entities.

Fishery Biologist Steve Reilly joined the *McArthur* in September as Cruise Leader. Fishery Biologist Robert Pitman continued with investigations of sea bird abundance as part of the sea bird census project, and he also sampled the surface fauna at night by dip netting while the vessel stopped for CTD-chlorophyll-nutrient stations. Oceanographer Lisa Lierhiemer continued on the *Jordan* with the CTD stations. She has been working alongside Oceanographer Greg Thomas from NOAA's Atlantic Oceanographic and Meteorological Laboratory, as part of the SWFC- AOML collaboration in the study of ETP oceanography on the MOPS cruises.

On both the *Jordan* and *McArthur*, sea bird observers conduct strip transect sighting surveys for birds and turtles, along side and independent of the marine mammal observers. The "birders" also conduct a manta tow each night during the first CTD station to sample the neuston of the area. The manta tow project is being carried out jointly with Fishery Biologist Geoff Moser's program in the Coastal Fisheries Resources Division. Moser's group has now completed sorting the many samples from MOPS 1987, and plan to begin identification work in early 1989.

Wildlife Biologist Lisa Ballance, a part-time student employee from UCLA, proceeded with processing of the bird census data collected during August, when she sailed with the *Jordan*. She has been given considerable advice and as-

sistance in handling the bird census data from Computer Programmer Analysts Chuck Oliver and Rick Tauber from the Multispecies Data Program in the Pelagic Fisheries Resources Division. Ballance will be studying some aspects of the MOPS bird data for her Ph.D thesis at UCLA, while collaborating with Reilly and Pitman in investigations relating to bird-dolphin-tuna ecology.

Oceanographer Paul Fiedler and Fishery Biologist Elizabeth Edwards departed in late October to join the *Jordan* for the fourth and last 30-day leg of MOPS 1988. Fiedler will take over oceanographic sampling duties from Lierhiemer so that he can gain a first-hand knowledge of the data collection protocols, while Edwards will act as Cruise Leader. See this column in the next Bimonthly Report for a full summary of our work during MOPS 1988. (S. Reilly, FTS 893-7164)

HONOLULU LABORATORY

Honolulu, Hawaii

INSULAR RESOURCES INVESTIGATION

Habitat of Several Juvenile Deepwater Snappers Documented

For the first time ever, scientists have documented the habitat of juvenile deepwater snappers in Hawaii. Six juvenile snappers (one *Aphareus rutilans* and five *Aprion virescens*) were caught by hook and line in about 40-70 m of water outside Kaneohe Bay off Oahu on 7 October 1988 by Biological Aid Frank A. Parrish and Fishery Biologist Thomas K. Kazama.

The deepwater snapper fishery is one of Hawaii's most valuable fisheries. Commercial fishermen in 1987 landed 1.8 million pounds of deepwater snappers valued at $5.3 million. Although adult habitat has been well documented, biologists did not know where the juveniles were located. The juveniles have not been documented from scuba diving and submersible observation, so there was some speculation that they may be found at deeper depths than the adults.

Selection of the study site was based on information obtained from a recreational fisherman who reported catching juvenile snappers occasionally while fishing there for wrasse, *Halichoeres* spp. Observed via scuba by Parrish, the site's bottom was a hard, flat coral base with no vertical relief and was covered by a thin veneer of sand. This habitat type differs markedly from the adult snappers' habitat, which generally consists of steep, rocky slopes in the 200 m depth range and with abundant vertical relief. A follow-up trip to the site on 18 October resulted in the capture of 25 juvenile opakapaka, *Pristipomoides filamentosus*. Documenting the juvenile habitat of these valuable commercial snappers is an important step in completing our knowledge of their life history. (J. Polovina (808) 943-1218)

Submersible Dives Conducted on the Kona Coast

Shrimp trapping operations were conducted off the island of Hawaii in the spring of 1988 to determine the relative abundance of *Heterocarpus laevigatus*, a large pandalid shrimp. Three sites on the Kona coast with widely ranging catch rates were selected for observations via a submersible. On 23-25 August, Fishery Biologist Robert B. Moffitt and Biological Aid Frank A. Parrish dove on these sites using the NOAA submersible *Pisces V*. Observations were conducted at bottom depths of 500-900 m, the habitat range of *H. laevigatus*, as determined in prior trapping studies. The bottom substrate differed among sites, with varying amounts of coraline and volcanic contributions, but all sites were very steep (ca. 30° slope).

Several interesting observations were made. First, although *H. laevigatus* is by far the most abundant shrimp caught in the traps, it was not the most abundant shrimp seen from the submersible. Instead, another pandalid shrimp, *Plesionika* sp., was much more abundant. Second, intensive trapping experiments have indicated *H. laevigatus* densities of up to one shrimp per 100 m^2 in an area where catch rates averaged about 20 kg/trap; however, densities observed from the submersible were much higher, about one shrimp per 10 m^2 in two different areas where trap catches were about 10 kg/trap. Further, although several bottom types were observed on each dive, *H. laevigatus* were not obviously associated with a single bottom type, be it coraline or volcanic, rocky or sandy. Finally, assessments using traps have caught several taxa of non-shrimp organisms, including fish, but the observations aboard the submersible indicated several taxa were available in numbers that have not been caught to date. Fur-

ther analysis will continue in order to gain a better understanding of the distribution of *H. laevigatus* and to correlate trap catch rates with submersible-observed shrimp densities. (R. Moffitt (808) 943-1236)

PELAGIC RESOURCES INVESTIGATION

Billfish Vital Rates Reviewed

In a paper to be published next year in the Proceedings of the Second International Billfish Symposium, Fishery Biologist Christofer H. Boggs reviews the research on billfish age, growth, and mortality, and discusses the application of vital rate statistics in stock assessment. The review notes that age- structured stock assessments of billfish are relatively recent developments. Much work on growth rates has been accomplished recently, but only two age-structured billfish assessments have been made, one for the western Atlantic stock of swordfish, *Xiphias gladius*, and one for Atlantic sailfish, *Istiophorus albicans*. The availability of adequate size- frequency data and growth models has been a limiting factor.

The implications of new growth models based on hard parts have not yet been fully examined, but hard part studies suggest much older ages than do earlier studies, based on analysis of length- frequency modes and growth of recaptured fish (Figures 1 and 2). The emerging picture is one of rapid growth during the first few years of life, followed by an extended lifespan after maturity, with very slow growth among older fish. Otolith ageing studies suggest that 15-year-old Pacific blue marlin, *Makaira mazara* and 30-year-old swordfish may not be unusual.

The review points out that the discrepancies between different methods of estimating billfish age and growth are so large that mortality estimates based on the wrong model could be biased by 100%. This level of accuracy is inadequate for meaningful stock assessment. Slower growth and lower mortality rate estimates suggested by hard part ageing studies indicate a slower turnover rate. This turnover rate is crucial in determining the amount of fishing the stock can sustain.

Age-structured stock assessment efforts have avoided using recent hard part growth estimates because of an absence of validation studies and frequent lack of verification in comparisons between hard part structures. At the Billfish Symposium (held 1-5 August 1988 in Kailua-Kona on the island of Hawaii) several papers describing the verification problem were presented. New techniques of verification indicate consistency between hard part structures, but validation remains extremely difficult for billfish. Increased attention to billfish tagging studies, resulting from the increased participation of sportfishermen, could help resolve discrepancies between growth estimates. Techniques should be promoted to improve size estimation at tagging and to administer hard part marking chemicals to validate growth rate estimates. In his paper, Boggs concludes that it would not be wise to wait for hard part age validation before ex-

Figure 1. Length (LJFL = lower jaw to fork length) versus age curves for swordfish, *Xiphias gladius*. M = male, F = female, and U = unknown or unreported.

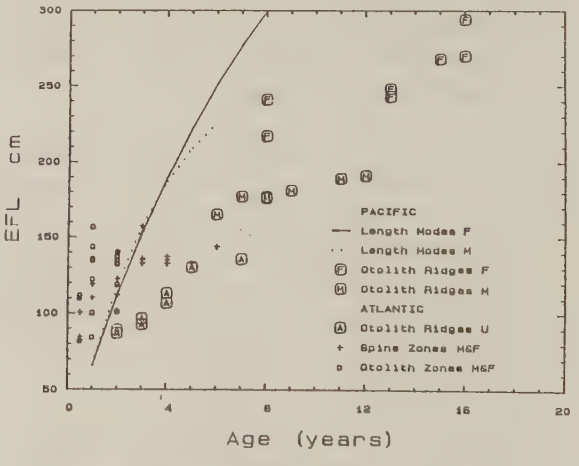

Figure 2. Length (EFL = eye to fork length) versus age data for Pacific blue marlin, *Makaira mazara*, and Atlantic blue marlin, *M. nigricans*. M = male, F = female, and U = unknown or unreported.

amining the implications of slow growth and extended lifespan on the status of billfish stocks. (C. Boggs (808) 943-1222)

Pelagic Management Unit Species Annual Report Module Is Completed

A draft of the Southwest Fisheries Center (SWFC) annual report module on pelagic management unit species (PMUS) was recently completed by Robert A. Skillman, Program Leader of the Pelagic FMP Research Program, and Reese A. Tokunaga, a Western Pacific Regional Fishery Management Council (Council) contractor. The module will be used by the Council's Pelagic Plan Monitoring Team for its annual report.

The report module is made up of two sections. The first consists of computer programs and procedures developed so that annual report modules, in the future, can be prepared by the island fisheries offices of American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands (CNMI). Specifically, dBASE computer programs have been written to compile statistics on landings, revenue, trips, and catch rates for their fisheries. Plotting procedures also have been developed to allow examination of trends and changes as stipulated in the pelagic FMP. The SAS procedures have been prepared for Hawaii data as well, but they have not been completely validated. Compilations for Hawaii have not been run because the data with vessel identifiers were not current when the computer programs were being developed.

The second section represents a report on SWFC research activities relating to PMUS. The first of three topics covered in this section is a brief interpretation of the tabulations and charts for American Samoa, Guam, and the CNMI modules. The second summarizes the Pacific billfish stock assessment paper by Skillman presented at the Second International Billfish Symposium in August. The third reports that the last of three pelagic ichthyoplankton survey cruises was completed in September and that analysis of PMUS larval distribution as affected by fine-scale oceanographic features will now be conducted. (R. Skillman (808) 943-1257)

Visiting Scientist Receives Training in Ageing Fishes

James H. Uchiyama, Fishery Biologist, reports that Rangsan Chayakul from the Thailand Marine Fisheries Laboratory, Bangkok, Thailand, arrived on 15 October to begin a 2-week training program. The training program, which focuses on ageing larval fish otoliths, is sponsored by the Indo-Pacific Tuna Development and Management Programme of the Food and Agriculture Organization of the United Nations in Columbo, Sri Lanka. Chayakul is in charge of identification and analysis of larval fish captured in the Gulf of Thailand. Extraction and processing have been initiated for otoliths from juvenile tongol, *Thunnus tongol*, and kawakawa, *Euthynnus affinis*, which were captured by purse seine in the Gulf of Thailand. (J. Uchiyama (808) 943-1220)

Ichthyoplankton Cruise Is Completed

Robert A. Skillman, Program Leader of the Pelagic FMP Research Program, reports that the third and final ichthyoplankton cruise was completed in September. The cruises' objective was to collect early life-history stages of pelagic management unit species (mahimahi,

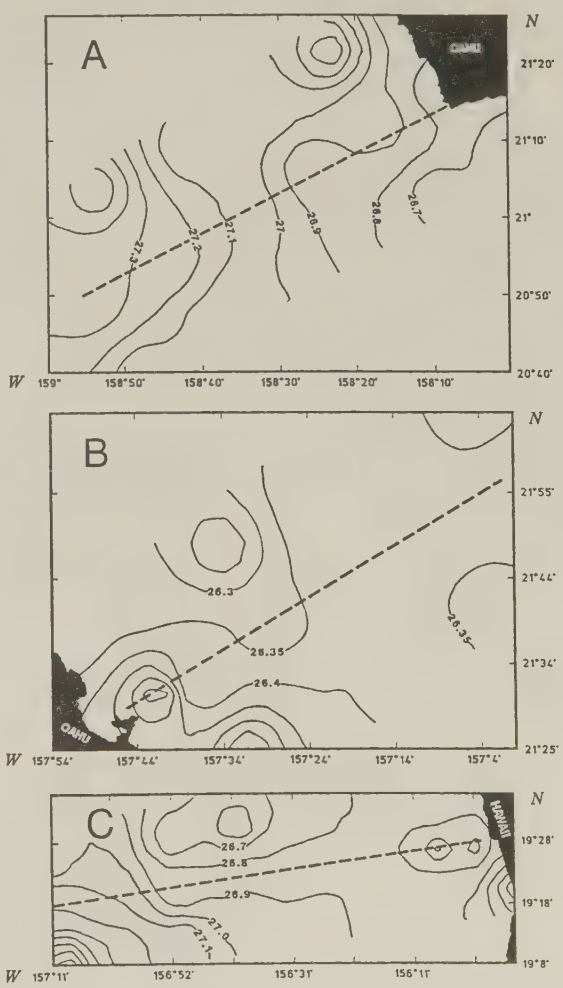

Figure 3. Contour plots of surface temperature in pelagic ichthyoplankton survey areas with biological survey lines superimposed: (A) leeward Oahu, (B) windward Oahu, and (C) Kona, Hawaii.

Coryphaena hippurus; ono (wahoo), *Acanthocybium solandri*; and the billfishes) to resolve fine-scale distributional patterns relative to onshore-offshore island effects, current flow, and other physical features. Ichthyoplankton samples (day and night Manta neuston net tows and night Isaacs-Kidd midwater trawl tows) were collected at sites on the leeward and windward sides of Oahu and, for the first time on the three cruises, at Kona, Hawaii. In addition, night-lighting was conducted an entire evening off Kona in an attempt to collect live, juvenile billfish. Thus, ichthyoplankton samples were collected at 24 day Manta net stations, 23 night Manta net stations, 23 night Isaacs-Kidd midwater trawl stations, and 1 night-light station.

In addition to the biological observations, oceanographic observations (XBT casts, CTD casts, continuous thermosalinograph and acoustic Doppler current profiler observations, and surface water samples) were collected along the biological survey line as well as along two parallel oceanographic lines. The orientation of the biological survey line with respect to the coastline and surface temperature features are illustrated in Figure 3. The water flowing through the channel north of Oahu caused marked dynamics of the thermal structure on the northern edge of the leeward survey area (Figure 4). (R. Skillman (808) 943-1257)

Billfish Stock Assessment Paper Is Completed

"Status of Pacific billfish stocks" by Robert A. Skillman was recently completed and will be published in the Proceedings of the Second International Billfish Symposium, Kailua-Kona, Hawaii, 1-5 August 1988. Prepared at the request of organizers, the paper updates the status of Pacific billfish stocks. With the increasing importance of recreational fishing for billfishes worldwide, interest in the biological status of billfish stocks has heightened. The first attempt at assessing the status of the billfishes on a Pacific-wide basis occurred at a workshop held in Honolulu in 1977, and Indian Ocean billfish stocks were included in a 1979 stock assessment workshop held in Shimizu, Japan.

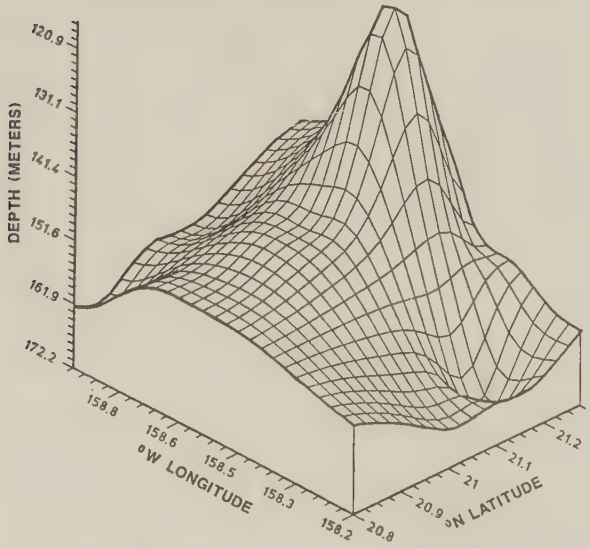

Figure 4. Perspective plot of the depth of the 20°C isotherm in the leeward Oahu sampling site.

The paper contains surplus production model assessments, using geographic index areas for computation of indices of stock abundance, for Indo-Pacific blue marlin, *Makaira mazara*; sword-fish, *Xiphias gladius*; and sailfish, *Istiophorus platypterus*, and shortbill spearfish, *Tetrapturus angustirostris*, combined. No attempt was made to fit the model to black marlin, *M. indica*, data nor to sailfish and shortbill spearfish separately because of data problems.

Specifically, black marlin catch data did not appear to vary as a function of fishing effort. Also, in the case of sailfish and spearfish, the size and placement of the Food and Agriculture Organization of the United Nations (FAO) fishery statistical areas made it impossible to artificially divide the total catch statistics for these two species based on knowledge of stock structure. No satisfactory fit could be obtained for striped marlin because of the linear nature of the relationship between catch and fishing effort. Average weight statistics, computed from reported logbook numbers and FAO weight statistics, did not always follow expected trends, particularly for striped marlin where the computed average weight has increased throughout the history of the fishery. The effect of deep longline gear was simulated by using assumed 25 and 50% reductions in the effective catch rate for billfish.

In general, the status of billfish stocks has improved in the latter part of the time series (late 1970's to 1980), as estimated total effective fishing effort declined. This is true particularly under the assumption of declining overall gear effectiveness with the more widespread use of deep tuna longline gear. The generalized production model of the blue marlin indicates that the harvest of this species still exceeds the

estimated maximum sustainable yield (MSY) of approximately 23,500 metric tons (t), but that the situation has improved with the use of deep longline gear (Figure 5).

For shortbill spearfish and sailfish, the generalized production model assessment indicates that the stocks are being harvested at the estimated MSY level of about 9,900 t. However, plots of catch rate (number of fish per 1,000 longline hooks) for sailfish and spearfish using index areas, where the statistics can be safely assumed to represent only one of the species, suggest that the sailfish stocks have undergone considerable reduction while spearfish stocks appear relatively stable. Using these two assessment tools suggests that sailfish are overharvested and shortbill spearfish may be underharvested.

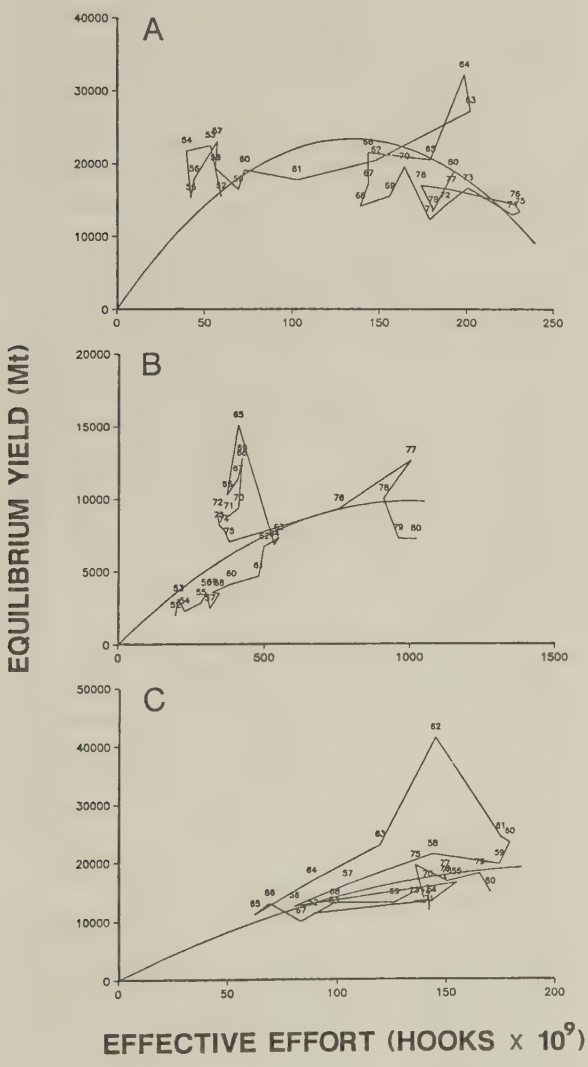

Figure 5. Surplus production model curved with observed (smoothed and adjusted) data for (A) blue marlin, (B) sailfish/spearfish, and (C) swordfish.

Lastly, the generalized production model assessment of swordfish indicates that the fishery is operating close to the estimated MSY level of approximately 19,000 t. The statistics for this fishery include three distinct phases: a night longline fishery directed at relatively small fish, a transition phase when day longline fishing directed at larger fish came into being and total fishing effort declined, and a third phase when the day longline fishery expanded. (R. Skillman (808) 943-1257)

FISHERY MANAGEMENT RESEARCH PROGRAM

Mid-1988 Honolulu Market Report Completed

The mid-year report on Honolulu fresh fish market monitoring by the National Marine Fisheries Service has been completed by Biological Technician Kurt E. Kawamoto. While the aggregate quantity of fish landed is confidential (published reports use scaled data), Kawamoto reports that mid-year landings increased by 10.5% over the 1987 mid-year mark. Landings of all species groups monitored increased, but landings from some areas declined.

Bottom fish landings from the Northwestern Hawaiian Islands were the lowest of the past 3 years, down 27.5% since mid-year 1987. Eleven vessels were active in the fishery, but many fishermen have expressed interest in the tuna longline and lobster fisheries. Limited entry will be implemented in this fishery in 1989. In the main Hawaiian Islands, bottom fish landings increased by 45%.

The tuna longline fishery continued its expansion, with landings increasing by 34% over 1987. High catch rates in late 1987 continued through the first months of 1988, and unusually large amounts of albacore, *Thunnus alalunga*, and striped marlin, *Tetrapturus audax*, were landed this spring. The number of active longline vessels equaled 39 by mid-year. None of the longline vessels has made a bottom fish trip this year. (S. Pooley (808) 943-1216)

Hawaii's Skipjack Tuna Fishery Improves

The skipjack (aku) tuna, *Katsuwonus pelamis*, pole-and-line fishery in Hawaii in 1987 has recovered substantially, according to "Hawaii's aku boat fishery in 1986 and 1987" (Administrative Report H-88-16) by Samuel G. Pooley, Shoji Teramoto, and Ann C. Todoki. After nearly 10 years of dramatic declines, catches rose in 1987 to the highest level since 1979. This increase has encouraged refurbishment of several vessels and the expansion of marketing outlets for fresh skipjack tuna. Imports for fresh-frozen skipjack tuna (primarily from Japan) dropped substantially. (S. Pooley (808) 943-1216)

Hawaii Seafood Buyer's Guide Is Available

The Hawaii Seafood Buyer's Guide has been published by the Hawaii Department of Business and Economic Development (DBED). The guide is a collation of multicolored brochures on major market species. The brochures highlight the key facts concerning availability, handling, and processing of some 20 species. The guide is available from the Hawaii DBED, P.O. Box 2359, Honolulu, HI 96804.

On a related note, Samuel G. Pooley, Industry Economist, conducted an informal seafood marketing survey while traveling on the mainland. He discovered yellowfin tuna, *Thunnus albacares*, from Hawaii being sold in restaurants in Jackson, Wyoming, and Pt. Reyes Station, California, and in supermarkets throughout Marin County, California. Restaurant competition in Jackson (population, 4,500) was fierce, with fresh fish arriving directly from wholesalers in Hawaii, the Gulf coast, Florida, California, and Washington. (S. Pooley (808) 943-1216)

Swordfish Sports Latest in Fish Fashion

A swordfish, *Xiphias gladius*, recently off-loaded at the Honolulu auction was wearing an item more common to newspapers and long hair than to fish. A rubber band was secured around the fish's tail, according to Michael Hiu, a Honolulu sampling assistant and University of Hawaii Marine Options Program student. The rubber band was in fact embedded in the flesh and muscle of the tail, but the fish appeared to be otherwise healthy (albeit now dead). Some auction buyers wondered whether the National Marine Fisheries Service was using a new type of age-sensitive tagging. Biological Technician Raymond P. Clarke of the Honolulu Laboratory and Jo-Anne Kushima of the Hawaii Division of Aquatic Resources photographed and documented this example of marine debris. (S. Pooley (808) 943-1216)

WPACFIN Fisheries Data Coordinating Committee Holds 10th Meeting

Members of the WPACFIN Fisheries Data Coordinating Committee (FDCC) met at the King Kamehameha Hotel in Kailua-Kona, Hawaii, on 8 August 1988. The FDCC is composed of chief fisheries officers from Pacific island state, territorial, commonwealth, and federal fisheries agencies, and is charged with overseeing and coordinating the design, implementation, and maintenance of WPACFIN. The status of 11 action items from the 9th meeting was discussed. Among these items were confidentiality agreements with American Samoa and the Commonwealth of the Northern Mariana Islands, assignment of island personnel to the Pelagics and Bottom Fish Plan Monitoring Teams, and project funding under the Interjurisdictional Fisheries Act. David C. Hamm, WPACFIN Program Manager, also gave a briefing on the design, implementation, and funding alternatives of "next generation WPACFIN." One of the most significant outcomes of the meeting was the addition of another Pacific island agency as an official participant in the WPACFIN family. By unanimous vote, the Guam Department of Commerce became the first addition to the FDCC since the FDCC's first meeting in August 1982. The Director of the Guam Department of Commerce, Peter Barcinas, will represent the Department on the FDCC. (D. Hamm (808) 943-1214)

Bottom Fish Plan Monitoring Team Annual Report Modules Developed

Annual report modules on the bottom fish fisheries in American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands (CNMI) were recently developed by WPACFIN Program Manager David C. Hamm and WPACFIN Computer Programmer Michael M. C. Quach, by using the central data bases established by WPACFIN and supported by limited quality control, editorial, and interpretive input directly from island personnel. The annual report modules on the status of the bottom fish fisheries in these islands and also Hawaii are part of the requirements of the Bottom Fish Plan Monitoring Team. At the request of fisheries offices in American Samoa, Guam, and the CNMI,

Hamm has been representing these islands on the various Fisheries Management Plan Monitoring Teams until official island representatives are appointed and trained to take on the responsibilities.

The modules summarize available information on the bottom fish management unit species in 1982-87 for American Samoa and in 1979-87 for the CNMI and Guam. Commercial and creel survey data were used to document the status of the fishery with regard to landings, revenue, fleets, catch per unit effort, and species composition. The three modules were provided directly to the Bottom Fish Plan Monitoring Team by Hamm on behalf of the island fisheries offices and were also presented in "Bottom fish fisheries of American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands" (Administrative Report H-88-15) for broader distribution. (D. Hamm (808) 943-1214)

Palau Government Assisted in Fishery Surveys

As part of the Honolulu Laboratory's continuing and expanding effort to provide technical assistance to other Pacific island fisheries agencies, staff of the WPACFIN program recently helped the Palau Marine Resources Division (PMRD) design and implement the Palau Subsistence Fishery Survey Project for collecting information on the fishing activities of Palauans, and also assisted PMRD in obtaining computers and software to process data collected by the surveys. The coordinated multiagency effort included a basic PL 88-309 grant from the National Marine Fisheries Service to the PMRD, a subcontract between PMRD and Principle Investigator Paul Gates of the Western Pacific Regional Fishery Management Council, technical assistance for survey design and computer processing from WPACFIN Program Manager David C. Hamm, and funding of Hamm's travel-related expenses by the South Pacific Commission.

The surveys use two questionnaires, one to collect information on fishing from a boat and one for fishing without a boat. The surveys will provide estimates of total and subsistence catches and verify the commercial catch estimates obtained from a system the PMRD implemented with WPACFIN assistance in 1983. Such information is necessary to determine whether fisheries management is needed in Palau. Besides the subsistence catch, the surveys will also provide information on the number of boats in Palau, the primary species harvested by each fishing method commonly used, and how fishermen compare fishing today with 5 years ago.

Conducting the actual surveys will be no easy task. All but one of Palau's 16 states are rural areas with villages spread across islands and atolls, many of which are approachable only by water and only at high tide. Palau also has a broad spectrum of lifestyles. The largest state, Koror, is fairly metropolitan, whereas the other states have no electricity nor modern conveniences.

To help ensure the success of the surveys, the questionnaire was field tested, resulting in several changes to reduce biases and eliminate ambiguities. The surveys are being conducted by three PMRD employees trained in survey techniques by Gates and Hamm. The surveyors are relying partially on cultural clan and family relationships to facilitate data collection and ensure accurate information.

In addition to assisting in the survey design and implementation, Hamm and WPACFIN Computer Programmer Michael M. C. Quach established a basic data base management and processing system to computerize and summarize the survey data. Additional quality control, report, and expansion modules will be developed once PMRD staff have entered some data from the surveys. (D. Hamm (808) 943-1214)

PACIFIC FISHERIES ENVIRONMENTAL GROUP

Monterey, California

FISHERY/ENVIRONMENTAL LINKAGES

Genetic Relationships of World's Subtropical Sardines Investigated

Fishery Biologist Richard Parrish has completed an analysis of the world's sardines; the work is co-authored by Rodolfo Serra of the Subsecretaria de Pesca (Santiago, Chile) and Stewart Grant of the University of the Witwaterstrand (Johannesburg, South Africa).

The work reviews the taxonomy, distribution, stock structure, biochemical genetics and zoogeography of the world's two subtropical sardines, *Sardina* and *Sardinops*. It is shown that the Nei's genetic distance (1.10) between *Sardina* and *Sardinops* is at the genus level; however, the genetic distances between the five presently accepted species of *Sardinops* (0.004 to 0.009) is more typical of genetic distances between conspecific populations rather than between species or even subspecies (Figure 1). It is concluded that both genera are monotypic and that the differences between populations of *Sardinops* in the Kuroshio, California, Peru, and Benguela current systems as well as those off Australia and New Zealand are not large enough to consider them distinct species or subspecies. All of the world's *Sardinops* populations would therefore become synonymized as *Sardinops sagax* (Jenyns). An interesting sidelight of the work demonstrates that the results of a series of traditional taxonomic studies on *Sardinops*, which were ignored, are consistent with the results of the newer biochemical techniques.

Analysis of biochemical genetics information, fossil evidence and present and paleo-climatic conditions suggests that *Sardinops* did not achieve its present distribution until the Pleistocene and that westward exchange of sardines via the northern and southern hemisphere's west wind drift regions is probable with present climatic conditions. Transequator exchange appears to be possible only during glacial maxima and only in the eastern tropical Pacific. The combination of the taxonomic material, the biochemical genetics work, and the paleo-climatic material provides a time scale which allows a new view of stock structure in pelagic marine fishes. The work suggests that the ocean is much more of an open system to pelagic fishes than has hitherto been thought. (R. Parrish (408) 646-3311)

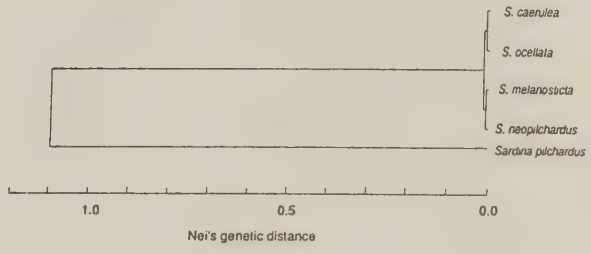

Figure 1. A UPGMA cluster analysis of Nei's genetic distances (Nei 1972) between species of *Sardina* and *Sardinops*. Genetic distances are based on data for 29 protein loci.

PELAGIC FISHERIES RESOURCES DIVISION

La Jolla, California

Review Panel Meets for Atlantic Bluefin Tuna Assessment

In 1974, the International Commission for the Conservation of Atlantic Tunas (ICCAT) adopted conservation measures for Atlantic bluefin tuna that limited fishing mortality to recent years. Despite the measures, the western Atlantic stock continued to decline. By 1981, it was clear that more stringent regulations were needed in order to arrest the decline. That year, ICCAT adopted an annual catch quota of 1,160 metric tons (mt) for the western stock. The quota was increased to 2,660 mt the following year, and has remained at this level since then.

Recent information suggested that the quota has not in fact stemmed the decline, and that the spawning stock is at a very low level. The Southeast Region, Miami Laboratory, was assigned responsibility to organize a review panel to evaluate the bluefin tuna assessments conducted by ICCAT. Gary Sakagawa, Division Chief of the Pelagic Fisheries Resources Division at La Jolla, was tapped to assist in organizing and to chair the review panel. Besides Sakagawa, the panel consisted of Saul Saila (University of Rhode Island), William Fox (University of Miami), Richard Hennemuth (recently retired from NMFS), Gordon Broadhead (LMR, Inc.), and Frank Hester (National Fisheries Institute). The panel completed its review on October 13 and submitted its findings to the Miami Laboratory.

In summary, the panel took the ICCAT bluefin tuna assessments at face value and for drawing conclusions, but with the caveat that the conclusions could change if a new ICCAT assessment deviates from the recent assessments. The panel concluded that the western stock is at a low level, will continue to decline in the near-term, and will require larger recruitment levels than has occurred in the recent past for it to increase; the ICCAT conservation program achieved its immediate objectives; and some specific immediate and long-term tasks need to be addressed in order to provide information for informed management decisions (G. Sakagawa, FTS 893-7177)

MULTISPECIES DATA COLLECTION AND EVALUATION PROGRAM

Report Published on U.S. 1987 North and South Pacific Albacore Fisheries

An estimated 6,458,296 pounds (2,929 mt) of albacore were landed by U.S. vessels in ports throughout California, Oregon and Washington in 1987, a decrease of 43.0% from the 11,338,940 pounds (5,143 mt) landed in 1986. No landings were reported from Hawaii in 1987. Even though albacore fishing was less successful in 1987 than in 1986, there was excellent fishing reported from an offshore 3° quadrangle area, 39-41°N lat. and 156-159°W long., during mid-July to mid-August and from an inshore 5° quadrangle area, 42-47°N lat. and 125-130°W long., during mid-September to mid-October. High CPUEs of 72.0 and 136.0 fish per day, respectively, were reported from these two areas. The inshore fishing started late in July with significant catches taken throughout August and September in waters off Oregon and Washington.

Sea-surface temperatures (SSTs) in the North Pacific early in the season were unusually cold in an area 30° to 45°N lat. and west of 140°W long. Offshore fishing started in early May in the southern boundary of a well defined subarctic front with SSTs of 2.0° to 4.0°C (3.6° to 7.2°F) below normal. Strong coastal upwelling from mid-September to mid- October may have contributed to the success of vessels fishing inshore off Cape Blanco north to Cape Flattery late in the season.

Approximately 50% of the total albacore catch was sampled for information on effort and catch, and 1% was sampled for length-frequency. The average length of albacore caught in 1987 was 68.9 cm (14.9 lbs), which was slightly smaller than in 1986, 69.8 cm (15.4 lbs). Fishing effort (3,120 days) in 1987 was significantly lower than in 1986 (4,482 days). Estimated annual catch-per-unit effort for a standard 45-foot vessel in 1987 was 70.0 fish per day, which is significantly lower than the 117.0 fish per day in 1986.

Commercial landings reported for the U.S. South Pacific albacore fishery were 1,650,000 lbs (748 mt). This fishery started late in December 1986 and continued through March 1987. It was concentrated south of French Polynesia between 32-42°S lat. and 126-157°W long. Approximately 69% of the fish were caught in waters 18.6° to 19.7°C (65.5° to 75.5°F).

Information on this fishery was compiled by Fishery Biologist Anthony P. Majors and Computer Programmer Analyst Christina H. Perrin of the La Jolla Laboratory, and Meteorologist Forrest R. Miller of the Inter-American Tropical Tuna Commission from information provided by cooperating fishermen and state biologists. A report, Administrative Report LJ-88-21, "Summary of the 1987 North and South Pacific albacore fisheries data," is available for public distribution. (A. Majors, FTS 893-7077)

STOCK ASSESSMENT AND FISHERY IMPACT ANALYSIS PROGRAM

TOPS Makes French Connection

In September, Dr. Pierre Kleiber, Fishery Biologist, traveled to France to participate in a meeting sponsored by the French Overseas Research Organization, OSTROM. The subject of the meeting was tuna and the environment. Much of the discussion dwelt on the effect of environmental variations on catchability of tuna (and hence on the accuracy and reliability of fishery data for indicating tuna abundance). The effects of environment on recruitment and productivity of fish stocks were also considered as were the problems of adapting physical and biological oceanographic models to predict environmental phenomena on temporal and spatial scales relevant to tuna. Systems for remote-sensing of relevant oceanographic data from aircraft and satellites were also presented.

Kleiber discussed and demonstrated the Tuna-vessel Observer Program Simulator (TOPS) model, which was created by himself and Dr. Elizabeth Edwards, Fishery Biologist (described in July-August 1988 SWFC Report on Activities). OSTROM scientists are interested in the TOPS model because it deals with movement of animals searching for localized areas of favorable conditions. Currently, TOPS deals with dolphin movements and with an arbitrary habitat quality topography. The OSTROM scientists would like to have a similar model of tuna movement and a less arbitrary habitat quality topography. They envision using their

satellite technology to predict the occurrence of "hot spots" for tuna, and they would like to investigate the ability of tuna to find and aggregate on such hot spots. Kleiber is preparing a proposal to work with OSTROM scientists in adapting the TOPS model for a cooperative tuna movement investigation. (P. Kleiber, FTS 893-7076)

1988 Billfish Tracking Experiments Completed

The Pelagic Fisheries Resources Division completed its 1988 billfish observation and tracking experiments off Southern California. The experiments were conducted as a joint effort with the California Department of Fish and Game (CDF&G), Long Beach. The purpose of this year's and previous years' sonic tracking efforts was to observe striped marlin and swordfish behavior in areas of high fishing activity within the Southern California Bight. The research vessel, *Yellowfin*, was contracted by CDF&G for the experiments.

Five striped marlin were successfully tagged with sonic tags, and tracked for periods of up to 26 hours during seven 5-day research trips. A total of 55 hours of tracking covering 62 nautical miles in the Southern California Bight was completed. Data for both horizontal movements and vertical depth variations were obtained for all successfully tracked fish. Two tagged marlin died shortly after release due to injuries sustained during capture. Two free swimming swordfish were tagged by a commercial harpooner, but both tags were shed, and no tracks were obtained. The cause of tag shedding is unknown. So far, 16 striped marlin have been successfully tagged and tracked in the Southern California Bight. Only one swordfish has been successfully tracked (in 1986). Weather, sea state, and sea surface temperatures were recorded routinely during the tracking. Twenty-two thermal profiles (XBT's) were also collected during the cruises.

Cooperation from commercial fishermen and the sport fishing community was tremendous. All five of the tagged marlin were hooked by recreational anglers, and donated to the project. Two additional fish were offered by anglers, but were not accepted because the *Yellowfin* was involved in tracking a tagged fish when the offers were made. (D. Holts, FTS 893-7186)

TIBURON LABORATORY

Tiburon, California

Planning of Bodega Fisheries Research Laboratory

Dr. Maxwell Eldridge reports that plans are proceeding for design and construction of a new National Marine Fisheries Service research facility, the Bodega Fisheries Research Laboratory (BFRL), located at the University of California Bodega Marine Laboratory in Bodega Bay, California. This facility will become the new home of the Southwest Fisheries Center, Tiburon Laboratory, that was created in 1962.

The firm of Howard Needles Tammen and Bergendoff has been contracted to prepare a concept study that includes preliminary architectural and engineering plans for the laboratory. The BFRL is being designed to meet the multidisciplinary research needs of the Tiburon Laboratory whose primary mission is to conduct field and laboratory research for management of the Pacific coast groundfish resources. Not only will the new facility be located adjacent to the groundfish habitat and fishery, it will also become part of the Bodega Marine Laboratory research enclave. This will result in increased opportunity for cooperative research.

The design concepts for the BFRL call for a state-of-the-art fisheries research building of approximately 32,000 square feet joined to a spacious parking and staging area. The structure will included four investigation complexes served by a biological laboratory, instrument room, special wet and dry storage rooms, and special use spaces such as "clean" rooms and dissection/pathology laboratories. There will be additional general service spaces such as a computer center, photography/drafting room, diving locker, walk-in freezer, shop, and extensive enclosed vessel support and storage rooms. A versatile seawater system and aquarium is planned that will have four experimental areas each fully serviced with utilities and a variety of seawaters (raw, filtered/sterilized, hot and cold).

Creation of the BFRL is a multi-step process that will extend over the next 3 years. Preparation of detailed construction drawings is scheduled after completion of the concept study. Then will come actual construction, equipping of

the facility, and the final move-in. Progress reports on this challenging and exciting project will be given periodically as important steps are completed. (M. Eldridge, FTS, 556-0569)

Contract Let to Develop Groundfish Port Sampling Model

At the present time west coast agencies are allocating groundfish sampling effort to times and locations on a "seat of the pants" basis. A more quantitative basis would be useful for allocating existing sampling manpower as well as for optimizing any augmentation. With the recent controversy about federal support for PacFIN and state sampling programs these considerations have become especially important.

With funding provided by the Southwest Region, the Tiburon Laboratory has let a contract for purchase of a groundfish sampling model. Specifically, the model will be used to:

1. Examine the benefits (precision of landings estimates) and costs associated with alternative levels of manpower assigned to groundfish sampling at ports in central and northern California;

2. Examine the benefits and costs associated with alternative distributions of a given level of manpower among ports and seasons; and

3. Aid management decisions on staffing and deployment of port samplers.

This is a pilot model, and will be restricted to port sampling in the State of California where the fish landings, sampling methods and statistical treatments have been described clearly. If the model proves successful, corresponding models can be developed for other states which employ different sampling and statistical methods. (A. MacCall, FTS 556-0565)

GROUNDFISH COMMUNITIES INVESTIGATIONS

Trends Identified in Distribution of Deep-slope Fishes

The fishes that inhabit the deep outer-slope of the continental shelf off California (depths: 200-1300 m) show trends in their distribution: 1) there are usually fewer species and less biomass at greater depths; 2) with increasing depth, many species are replaced by close relatives (generally of the same order); 3) there is an increase in size with depth among some species above 700 m, but (with two exceptions, noted below) no relation between size and depth is evident among the fishes below 700 m. These findings result from work by Fishery Biologists Peter Adams and Wayne Samiere of the Groundfish Communities Investigation, who analyzed collections from the 1987-88 SWFC Dover sole surveys.

Depth was the major factor affecting the distribution of individuals and species in this environment. Thus, the average number of species collected decreased from 19.8 at 200 m, to 11.1 at 1300 m (Figure 1). At the same time, average weights of the collections fell from 300.3 kg at 200 m, to 160.6 kg at 1300 m.

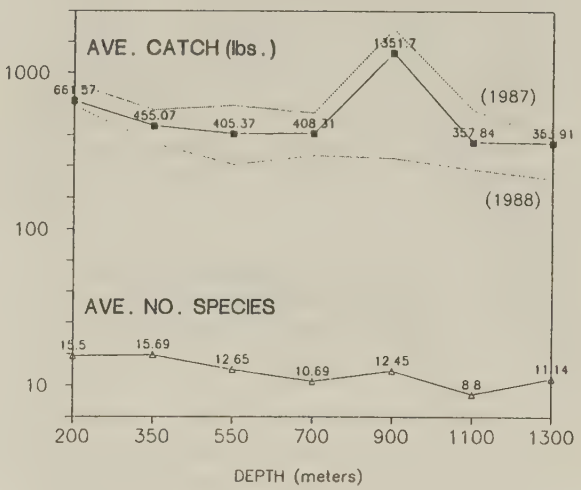

Figure 1. Species number and average catch (lbs.) by depth for the 1987-88 SWFC Dover sole survey.

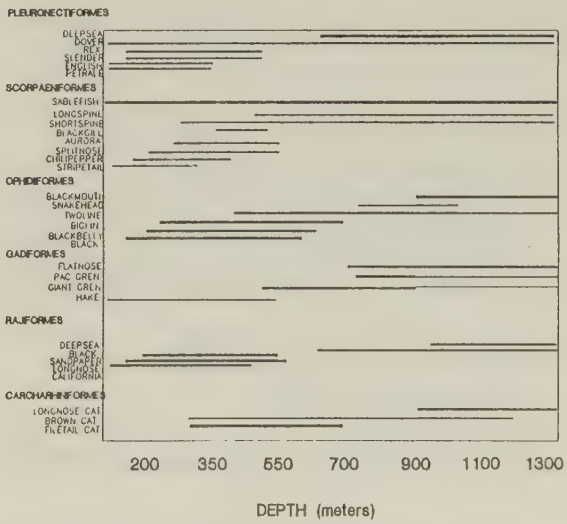

Figure 2. Species depth distribution from the 1987-88 SWFC Dover sole cruises.

Six distinctive groups of fishes, each a recognized taxonomic order, were represented among 70 of the 75 commonly occurring deep-slope fish species. The distribution of species with depth within each of these groups (Figure 2) demonstrates the pattern of species replacement. Each group was represented by at least one species at every depth-zone sampled.

Two of these groups, the Scorpaeniformes and the Pleuronectiformes included 82% of the total fish biomass sampled. Among the Scorpaeniformes, several species of rockfishes, sculpins, and lingcod occurred at the shallower depths, while several other rockfishes, the aurora, the splitnose and the blackgill were at the shallower to intermediate depths, and the two *Sebastalobus* species, the longspine and the shortspine thornyheads were at the mid to deeper depths. Among the Pleuronectiformes, the sanddab, petrale sole and the English sole occurred at the shallower depths, the rex sole and the slender sole at the shallower to mid depths, and the deepsea sole only below 700 m. The sablefish and the Dover sole, on the other hand, occurred over the entire range of depths sampled.

Three depth-related life-history patterns were evident. One involves movement into deeper water with age, and results in larger individuals being at greater depths than smaller ones, but always shallower than 700 m. (Species included: chilipepper and splitnose rockfishes; rex and petrale soles.) A second pattern was an absence of such movement, with individuals remaining at the same depths throughout their lives, but always deeper than 700 m. (Species included: longspine thornyhead, deepsea sole, and Pacific grenadier.) The third pattern, like the first, has movement into deeper water with age, but ranging throughout the depths sampled. (Species included: sablefish and Dover sole.) (P. Adams, FTS 556-0568)

GROUNDFISH ANALYSIS INVESTIGATIONS

Pelagic Juvenile Rockfishes Occurred Early and Often in 1988

The annual midwater-trawl survey of pelagic juvenile rockfish, carried out by the Groundfish Analysis Investigations from the NOAA Ship *David Starr Jordan* yielded high catches for the second consecutive year in 1988. Visiting Fishery Biologist Dr. Ralph Larson and Biological Technician Carol Reilly report that not only were catches relatively large in 1988 but the abundances of several species peaked relatively early in the year (Figure 3).

The duration and timing of occurrence of pelagic juvenile rockfish seems to differ among species in consistent ways. Some species, like *S. jordani* and *S. paucispinis* are present for extended periods of time, while others, like *S. entomelas* and *S. mystinus* occur more briefly. Some species like *S. goodei* tend to peak earlier in the year than others, and even subtle differences in timing can occur between species. The differences between species in the duration and timing of their occurrence as pelagic juveniles is probably related to the frequency and timing of spawning.

The timing of occurrence also varies from year to year within species. The relatively early occurrence of juvenile rockfishes in 1988 is evident in *S. jordani, S. goodei, S. paucispinis*, and *S. mystinus*.

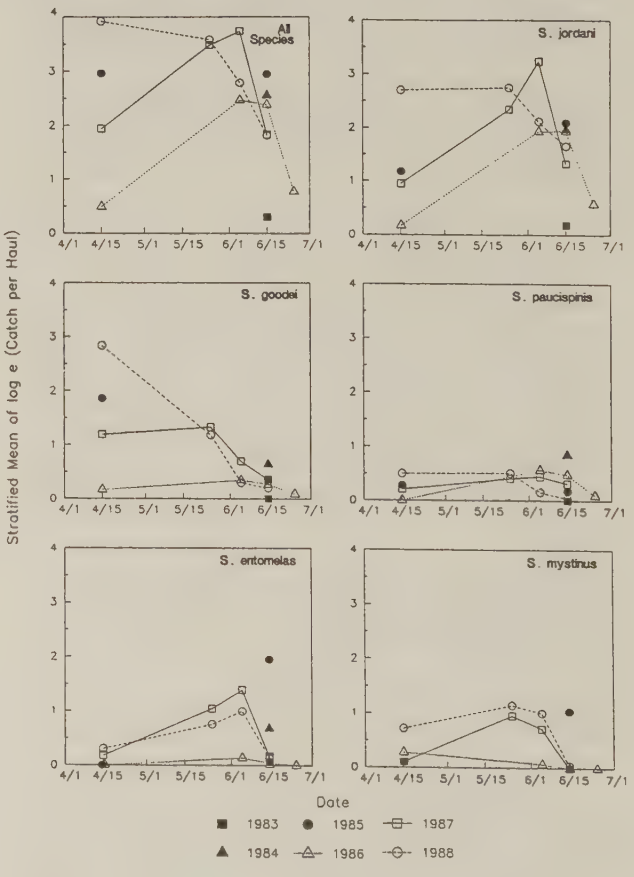

Figure 3. Stratified mean catch per midwater trawl of pelagic juveniles of five species of *Sebastes* and the total of all *Sebastes*, 1983-1988.

The latest seasonal occurrence to date occurred in 1984, when surveys carried out from June 12-27 yielded unusually large catches for that time of year in some species, such as *S. paucispinis*, *S. goodei*, and *S. entomelas*. The causes of these within-species shifts in timing remain to be determined.

Shifts in timing somewhat confound the interpretation of year-to-year differences in abundance, particularly for the years before 1986, when sampling was not replicated temporally. However, it appears that several species, such as *S. goodei*, *S. entomelas*, and *S. mystinus*, had strong year classes in 1985, 1987, and 1988. The 1986 year class was poor in several species, but relatively strong in *S. paucispinis* and *S. jordani*. It is interesting that the strong El Niño year of 1983 yielded year-class failures in all of the species sampled, but the weak El Niño year of 1988 yielded strong year classes. (R. Larson, FTS 556-0568)

GROUNDFISH PHYSIOLOGICAL ECOLOGY INVESTIGATIONS

Use of Oceanographic Data in Yellowtail Rockfish Studies

The Groundfish Physiological Ecology Investigations are presently completing data analysis for measurements of yellowtail rockfish made over the past 3 years. The relationship between environmental variables (e.g. upwelling and temperature) to the condition and reproduction of the fish collected at Cordell Bank is being examined.

Brian Jarvis, Biological Technician, has accumulated and summarized the environmental data. Among data obtained is the upwelling index developed by the Pacific Fisheries Environmental Group of Monterey. The upwelling index for a given sampling date was averaged for 10 and 30 days previous to collection. The 10-day average may indicate any short term influence and the 30-day average longer term influence of upwelling.

We are also summarizing temperature data collected by the NOAA weather buoy located north of Cordell Bank, temperature data from the University of California, Bodega Marine Laboratory, and temperature measurements taken on collection trips for this study.

Preliminary results of analysis of the relationship of temperature and upwelling to several condition variables shows significant differences among years. More analysis must be done before final conclusions are made. (J. Whipple, FTS 556-0569)

Planning for Sampling of Yellowtail Rockfish (*Sebastes flavidus*)

The staff of the Tiburon Laboratory has completed initial planning for the sampling of yellowtail rockfish from two areas: 1) off Bodega Bay, California, and 2) off Gray's Harbor, Washington. The condition and reproduction of adult yellowtail rockfish sampled from the two areas will be compared by examining a selected set of variables determined from monthly sampling of yellowtail rockfish off Cordell Banks for the last 3 years. Dr. Maxwell Eldridge and Brian Jarvis are going to Gray's Harbor, Washington the week of November 14th to complete arrangements for sampling. (M. Eldridge, FTS 556-056)

INFORMATION TECHNOLOGY SERVICES

Progress on Information Technology 1995 (IT-95) Project

Information Technology Services hosted a seminar on September 29 by Hoyt Wheeland, Chief of the NOAA Fisheries Office of Research and Environmental Information. The theme was "Everything You've Always Wanted to Know About IT-95." Mr. Wheeland presented an overview and status of the project, which would provide a distributed processing system to satisfy the complex scientific and data management needs of NOAA Fisheries. The procurement would provide hardware and software for standalone and network processing capabilities at 7 initial sites. The initial sites are Seattle, Auke Bay, La Jolla, Honolulu, Miami, Woods Hole, and Washington, DC.

The document answering the vendors' responses to the Request for Comments to

procure the systems was issued October 1. The Request for Proposal (RFP) to the vendors will be released upon the obligation of $2 million for FY-89. For a nominal purchase fee, interested vendors will be provided with a benchmark package.

The benchmark package is under development by the benchmark team, who will also serve as the Technical Review Committee. The team members from the regional sites are Chairperson, Bob Riemann (NW), Frank Kikuchi (NW), Roger Hewitt (SW), Charlie Krouse (SE), Jim Sargent (NE), and Dick Schween (RE1). The RFP and reports from the Technical Review Committee will be reviewed by the Source Selection Advisory Board (SSAB). The SSAB members are Chairperson, Hoyt Wheeland (RE2), IT95 Project Manager, Michael Fraser (RE2), Ted Rodgers (NW), Dorothy Roll (SW), Mary Anne Treadway (SE), and Gene Heyerdahl (NE)

The SWC staff who attended Mr. Wheeland's seminar showed a keen interest in the progress to date and the proposed funding options for the systems. The options are 1) lease with the $2 million for part of FY89, 2) lease with option to purchase, and 3) purchase. The 6 year life cycle estimate for the purchase is $16.4 million. The alternatives, proposed by Mr. Wheeland, for funding the FY89 $2 million to lease the 7 systems are reprogramming, carry-over, and tax add-ons.

At the Board of Directors meeting in mid-November, Mr. Wheeland will request the obligation of $2 million in order to issue the RFP to vendors for bids. He will propose the leasing of the systems for the 7 sites as the only option.

John Carr, Al Coan, Rich Charter, and Dorothy Roll met on October 27 to discuss the IT-95 agenda item for the Board of Controls meeting. They developed a recommendation on the SW regional position for the funding of the IT-95 system. Jerry Hornof at the SW Region Office agreed with the recommendation developed at this meeting. The recommendation will be given to Dr. Barrett and Mr. Fullerton for consideration as SW regional's position in response to Mr. Wheeland's presentation at the mid-November meeting. (D. Roll, FTS 893-7057)

STATUS OF PUBLICATIONS

Published

Boveng, Peter, Douglas P. DeMaster and Brent S. Stewart. 1988. Dynamic response analysis. III. A consistency filter and application to four northern elephant seal colonies. Mar. Mammal Sci. 4(3):210-222.

Dynamic response analysis, a technique for determining stock size relative to the maximum net productivity level (MNPL), was applied to northern elephant seal populations from the South Farallon Islands, Año Nuevo Island, San Nicolas Island and San Miguel Island. Pup counts were used as indices of population size. The application of dynamic response analysis presented here involved some methodological innovations. We present a moving interval method which involves calculating separate dynamic response analyses for intervals of various lengths ranging from four counts to the total number available for the colony. The sign of the second order polynomial regression coefficient computed from a particular interval was used to indicate the colony's apparent status (relative to its MNPL; + = above MNPL, - = below MNPL) on that interval. Consistency in the sign of the second order coefficient, as the interval was moved along the trajectory, was used to determine the minimum reliable interval size. Each colony exhibited growth similar to that of a population below its MNPL. These results are consistent with recent natural history observations at San Nicolas, San Miguel and the South Farallon Islands. Natural history observations at Año Nuevo Island suggest that the colony there is now at equilibrium. Thus, if our results from dynamic response analysis of the Año Nuevo colony are correct, it appears that the MNPL may be close to the carrying capacity for these animals.

Emerson, W. K. and R. B. Moffitt. 1988. A new genus and species of prosobranch gastropod (? Fasciolariidae) from the Mariana Islands. The Veliger 31(1/2):43-45.

A new genus and species of prosobranch gastropod, *Falsilatirus pacificus*, is described from deep water off Arakane Reef, in the Northern Mariana Islands. The questionable placement of this new species in the family Fasciolariidae is based on shell characters owing to the unavailability of soft parts for study.

Gerrodette, T. 1988. Dynamic response analysis. II. Evaluation of dynamic response analysis in a simulated no-harvest case. Mar. Mammal Sci. 4:196-209.

A new method of stock assessment, dynamic response analysis, allows a qualitative assessment of stock status relative to its level of maximum net productivity to be carried out with minimal data. This paper evaluates the performance of dynamic response analysis on a simulated population under variable conditions with uncertain data. In the no-harvest case the data consist simply of a temporal sequence of relative population sizes. Dynamic response analysis is most sensitive to the number and precision of the population estimates and least sensitive to environmental variability and the intrinsic population growth rate. Significance levels must be chosen carefully, since some combinations of parameters and error levels result in an unacceptably low proportion of correct assessments. Dynamic response analysis can be a useful stock assessment technique for the management of marine mammals, but attention must be paid to the quantity and quality of the data.

Henderson, J. R., and T. C. Johanos. 1988. Effects of tagging on weaned Hawaiian monk seal pups. Wildl. Soc. Bull. 16:312-317.

Huppert, Daniel D. 1988. Comment on the role of objectives in fisheries management. *In* Warren S. Wooster (ed.), Fishery Science and Management, Objectives and Limitations, p. 183-186. Springer-Verlag, New York.

Johanos, Thea C. and Reid P. Withrow. 1988. Hawaiian monk seal and green turtle research on Lisianski Island, 1987. U.S. Dep. Commer., NOAA Tech. Memo., NOAA-TM-NMFS-SWFC-121, 18 p.

The endangered Hawaiian monk seal, *Monachus schauinslandi, and threatened green turtle, Chelonia mydas,* on Lisianski Island in the Northwestern Hawaiian Islands were studied during 1-4 June and 5-29 August 1987. Data were collected on haul out, reproduction, and factors affecting survival. Monk seal census counts excluding pups of the year ranged from 77 to 112 seals ($\bar{x} = 93$) during 7-27 August. There were 125 individual seals identified. At least 19 pups (12 males, 6 females, and 1 of unknown sex) were born in 1987. Two of three observed parturient females were identifiable from previous years. At least eight seals moved between Lisianski and Laysan Islands since the 1986 field season. Minimum first-year survival of tagged 1986 pups was 90%. At least 10 seals sustained injuries. A pup of unknown sex died as the result of entanglement, and two other seals bore newly acquired entanglement scars. Three pups of the year disappeared during the field season, and five dead seals were found. Census counts of basking turtles ranged from zero to five turtles ($\bar{x} = 2$). One turtle was identified by a tag applied in a previous field season, and 34 excavation pits were found. One dead turtle was found. Scat, spew, and necropsy samples were collected. In addition, 140 items of net and fishing debris were sampled and destroyed.

Lasker, Reuben. 1988. Food chains and fisheries: An assessment after 20 years. *In* B. J. Rothschild (ed.), Toward a theory on biological-physical interactions in the world ocean, p. 173-182. Kluwer Academic Publishers.

Oceanic food chain research has been notably unsuccessful in predicting fish yield, chiefly because of inadequate methods for determining primary production and for the lack of data on transfer efficiencies between steps in food chains. Methods have improved in recent years in assessing primary production (both recycled and new) but the state of the science does not yet permit grand means of primary production to be assigned to the world's oceans nor for them to be used to predict fisheries yield.

Olney, J. E., and G. W. Boehlert. 1988. Nearshore ichthyoplankton associated with seagrass beds in the lower Chesapeake Bay. Mar. Ecol. Prog. Ser. 45:33-43.

Perrin, W. F. 1988. Dolphins, porpoises, and whales. An action plan for the conservation of biological diversity: 1988- 1992. International Union for Conservation of Nature and Natural Resources, IUCN Gland, Switzerland, 29 p.

Setzler-Hamilton, E. M., J. A. Whipple and R. B. MacFarlane. 1988. Striped bass populations in Chesapeake and San Francisco Bays: Two environmentally impacted estuaries. Mar. Pollut. Bull. 19(9):466-477.

Squires, Dale. 1988. Index numbers and productivity measurement in multispecies fisheries: An application to the Pacific coast trawl fleet. U.S. Dep. Commer., NOAA Tech. Rep. NMFS-67, 34 p.

This study is concerned with the measurement of total factor productivity in the marine fishing industries in general and in the Pacific coast trawl fishery in particular. The study is divided into two parts. Part I contains suitable empirical and introductory theoretical material for the examination of productivity in the Pacific coast trawl fleet. It is self- contained, and contains the basic formulae, empirical results, and discussion. Because the economic theory of index numbers and productivity is constantly evolving and is widely scattered throughout the economics literature, Part II draws together the theoretical literature into one place to allow ready access for readers interested in more details.

The major methodological focus of the study is upon the type of economic index number that is most appropriate for use by economists with the National Marine Fisheries Service. This study recommends that the following types of economic index numbers be used: chain rather than fixed base; bilateral rather than multilateral; one of the class of superlative indices, such as the Tornqvist or Fisher Ideal.

Squires, Dale and James Kirkley. 1988. A limited information approach for determining capital stock and investment in a fishery. Fish. Bull., U.S. 86(2):339-349.

Approved, Science and Research Director, SWR

Bakun, Andrew. Recruitment in fishery resources and its relation to environmental accessible pathways to greater insight. For publication in Simposio Internacional Sobre Recursos Vivos Y Pesquerias En El Pacifico Sudeste, Vina de Mar, Chile, 9-13 Mayo, 1988.

Boehlert, George W., Mary M. Yoklavich and Dudley B. Chelton. Time series of growth in the genus *Sebastes* from the northeast Pacific Ocean. For consideration for publication in Fishery Bulletin, U.S.

Boggs, Christofer H. Vital rate statistics for billfish stock assessment. For publication in the Proceedings of the International Billfish Symposium, Kailua-Kona, Hawaii, August 1- 5, 1988.

Edwards, Elizabeth and Pierre Kleiber. Effects of nonrandomness on line transect estimates of dolphin school abundance: Results from TOPS, a simulation model shaved by OCCAM's razor. For consideration for publication in Fishery Bulletin, U.S.

Eliason, Julie J., Thea C. Johanos and Marc A. Webber. Parturition in the Hawaiian monk seal *Monachus schauinslandi*. For consideration for publication in the Journal of Mammalogy.

Everson, Alan R., Happy A. Williams and Bernard M. Ito. Maturation and reproduction in two Hawaiian eteline snappers; uku, *Aprion virescens*, and onaga, *Etelis coruscans*. For consideration for publication in Fishery Bulletin, U.S.

Herrick, Jr., Samuel F. and Dale Squires. Integration of United States, Thailand, and Philippines canned tuna markets. For consideration for publication in the Journal of Asian Fisheries Science.

Hightower, Joseph E. and William H. Lenarz. Using GENMOD to develop harvesting policies for multi-aged fish stocks. For consideration for publication in American Fisheries Society - Mathematical Analysis of Fish Stock Dynamics.

Hobson, Edmund S. Predation on ocean krill. For consideration for publication in Science.

Jones, David R., R. W. Brill, P. J. Butler, P. G. Bushnell and M. R. A. Heieis. Measurement of ventilation volume in free swimming tunas. For consideration for publication in the Journal of Experimental Biology.

Mundy, B. C. Development of larvae and juveniles of the alfonsins, *Beryx splendens* and *B. decadactylus* (Berycidae, Beryciformes). For consideration for publication in the Bulletin of Marine Science.

Parrish, R. H., R. Serra and W. S. Grant. The monotypic *Sardina* and *Sardinops*: Their taxonomy distribution, stock structure and zoogeography. For consideration for publication in the Canadian Journal of Fisheries and Aquatic Sciences.

Skillman, Robert A. Stock identification and billfish management. For publication in the Proceedings of the International Billfish Symposium, Kailua-Kona, Hawaii, August 1- 5, 1988.

Ueyanagi, Shoji, Richard S. Shomura, Yoh Watanabe and James L. Squire. Trends in fisheries for billfishes in the Pacific. For publication in the Proceedings of the International Billfish Symposium, Kailua-Kona, Hawaii, August 1-5, 1988.

Administrative Reports

Forney, Karin. 1988. Contour mapping and the calculation of areas between 10 m depth contours along the coasts of California, Oregon and Washington. SWFC Admin. Rep., La Jolla, LJ-88-23, 12 p.

Gilmartin, W. G. 1988. The Hawaiian monk seal: Population status and current research activities. SWFC Admin. Rep., Honolulu, H-88-17, 14 p.

Hamm, D. C. and M. M. C. Quach. 1988. Bottom fish fisheries of American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. SWFC Admin. Rep., Honolulu, H-88-15, 76 p.

Honda, V. A., G. S. Yamasaki, and R. Y. Ito. 1988. American Samoa purse seine fishery sampling. SWFC Admin. Rep., Honolulu, H-88-20, 35 p.

Ito, R. Y., and G. S. Yamasaki. 1988. Status of the American Samoa foreign longline tuna fishery, 1982-86. SWFC Admin. Rep., Honolulu, H-88-19, 30 p.

Pooley, S. G., S. Teramoto and A. C. Todoki. 1988. Hawaii's aku boat fishery in 1986 and 1987. SWFC Admin Rep., Honolulu, H- 88-16, 15 p.

Ralston, S., and H. A. Williams. 1988. Age and growth of *Lutjanus kasmira, Lethrinus rubrioperculatus, Acanthurus lineatus*, and *Ctenochaetus striatus* from American Samoa. SWFC Admin. Rep., Honolulu, H-88-18, 11 p.

Squires, Dale and Daniel D. Huppert. 1988. Measuring harvesting capacity in the Pacific coast groundfish fleet. SWFC Admin. Rep., La Jolla, LJ-88-24, 19 p.

Translations

Kotlyar, A. N. 1984. Descriptions of the fries of the four species in the genus *Hoplostethus* (Trachichthyidae, Beryciformes). Moskovskoe Obshchestva Ispytatelei Prirody. Biulleten Otdel Biologicheskii 89(3):33-39. (Moscow Society of Naturalists. Bulletin of the Biological Section.) (Engl. transl. by W. G. Van Campen, 1988, 8 p., Transl. No. 129; available Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396).

Wada, T., and M. Murata. 1985. Distribution and biological characteristics of pomfret, *Brama japonica* Hilgendorf, in the Pacific Ocean off northern Japan. Bulletin of Hokkaido Regional Fisheries Research Laboratory 50:1-12. (Engl. transl. by W. G. Van Campen, 1988, 18 p., Transl. No. 128; available Southwest Fish. Cent. Honolulu Lab., Natl. Mar. Fish. Serv., NOAA, Honolulu, HI 96822-2396).

UNITED STATES
DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
SOUTHWEST FISHERIES CENTER
8604 LA JOLLA SHORES DRIVE
P.O. BOX 271
LA JOLLA, CALIFORNIA 92038

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE, $300

AN EQUAL OPPORTUNITY EMPLOYER

POSTAGE AND FEES PAID
DEPARTMENT OF COMMERCE
210

THIRD CLASS